LEVEL II

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Research Report 1295

A RESOURCE PLANNING AID FOR ASSESSING THE PERSONNEL AND LOGISTICS IMPLICATIONS OF TACTICAL OPERATIONS

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U. S. Army
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This report describes the research performed by the System Development Corporation (SDC) to develop data processing techniques to enhance the performance of personnel and logistics at corps and subordinate echelons. The research focussed on admin/log functions that relate directly to tactical command and control. European and CONUS Corps provided principal sources of data used to isolate Resource Planning as the function most needing support. A conceptual job aid was then developed to support the area under investigation and tested using a modified CGSC scenario to determine —(over)

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19. Tactical Command and Control System (TC^2S)
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20. Feasibility. An evaluation briefing on the methodology was prepared, in concert with CACDA and ARI, and presented to staff officers in the European Theater to determine its ability to fulfill the needs of the user. The major finding of the evaluation is that the methodology is needed and should be considered for implementation in European Theater.

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FOREWORD

System Development Corporation (SDC) submits this report to the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) in accordance with contract number DAHC19-77-C-0018, "Continuation of Work to Optimize the Effectiveness of Command Post Functions: Identification and Evaluation of Methods and Procedures for Processing Personnel Admin and Logistical Data at the Corps Level."

SDC personnel performed the research at Fort Leavenworth, Kansas during the period 8 February 1979 - 7 February 1980. The project staff, colocated with the ARI Field Unit, consisted of Dr. R. N. Parrish, Project Manager, and Mr. G. W. Stevens. Mr. J. E. Boydstun and Mr. J. Copes provided support from the Company's home office, and Mr. M. W. Lawless and Mr. L. P. McDonald provided consulting services. Mr. Steven R. Stewart, ARI Fort Leavenworth Field Unit, served as the Contracting Officer's Technical Representative (COTR).

This report documents the third year's effort under the contract. The purposes of the report are to describe work performed to select and validate a personnel administration and logistics function requiring performance enhancement, to develop a concept for a data processing methodology to meet that requirement, and to evaluate that concept in a field environment.

JOSEPH ZEIDNER
Technical Director

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Admin and Log Centers

The thirty-three staff personnel who contributed their time and descriptions of associated projects.

USAREUR and Corps Headquarters

The eighty-four HQ USAREUR and III, V, VII, and XVIII Corps staff personnel who contributed their hospitality, time, and descriptions of their tactically-related operations and responsibilities, and the 87 officers in USAREUR who participated in the evaluation of the methodology.

EXECUTIVE SUMMARY

OBJECTIVES

The third and final year of this contract had three goals: (1) to select and validate a computer based job aid to support corps-level, tactically-related admin/log functions that could not be performed adequately with current manual procedures; (2) to develop a conceptual design for that job aid; and (3) to evaluate the concept in a field environment.

SELECTION AND VALIDATION OF THE JOB AID

A review of Army literature and interviews with officers at Fort Leavenworth who had past experience in corps-level staffs led to the identification of three potential job aids: resource planning, force composition planning, and battlefield dispatch of weapon systems. Each potential aid met previously established selection criteria which included tactical relevance and need for performance enhancement.

To validate these job aids and select one for further work, visits were arranged to two corps headquarters in USAREUR and two in CONUS. Discussions with principal officers of the G1, G3, and G4 elements confirmed that the job aids addressed admin/log functions that had tactical relevance, and that each functional area needed performance enhancement. With one exception, the officers ranked resource planning first in importance and most in need of enhancement. They generally ranked force composition planning second, and rejected battlefield dispatch assistance as unworkable.

In-depth investigations of the sub functions underlying resource planning and force composition planning were conducted by means of job and task analyses. Results indicated that resource planning is currently performed entirely with manual methods requiring extensive calculations and that better forecasting methods are needed for tactical planning purposes. Force composition planning involved relatively little data processing, and could be supported manually if the staff had improved data of the type available from the proposed resource planning aid.

To assure the most current basis for concept development, and to avoid duplication of effort, visits were made to the ADMINCEN and LOGCEN to learn about current or planned projects that might impact the effort reported here. Two such projects were discovered, one in each center. The Administration Planning Factors Development project is working on a new model for forecasting casualties by MOS or SSI and grade. The project is trying to determine new planning factors, consisting of the probability of a loss for each MOS/SSI-grade combination, given information about operational parameters. The

Planning Factors Management Project at the LOGCEN is similar in intent. Designed to develop new planning factors for all classes of supply except I and VI, the project is also working on a model to forecast class VII.

The Centers' models and planning factors which are under development appear to be appropriate for replacement and resupply purposes. However, their planned outputs are overly detailed for most tactical planning purposes. To be maximally useful in tactical planning, additional data processing would be required.

At a meeting of CACDA, ARI, and SDC representatives, the results of the selection and validation process were presented, along with a recommendation to devote the remainder of the contract year to developing and evaluating a concept design for a Resource Planning Aid. This recommendation was accepted.

Analyses of information gathered during the selection and validation process revealed various user needs in resource planning. Two general needs are to support the commander's decision making process and to implement the commander's concept once his decision is made. More specific needs include improved data processing support in all areas, including collection, retrieval, and synthesis, forecast generation, and forecast comparisons involved in resource planning. Improvements in these areas should incorporate minimal input requirements, clear and simple input procedures, user controlled outputs, capability to modify inputs selectively during "what if" games, and a real-time, interactive capability.

Any data processing methodology to fill these needs should use a data base assembled from existing and planned reporting systems, rather than require new special data collection methods. The new aid should be able to retrieve any raw data item from its own data base, or the result of any computation it performs. It should be able to aggregate data by echelon, or by groups defined in accordance with commander's guidance. Forecasts should be generated at any level of detail specified by the user, taking into account replacement and resupply as well as present for duty or on-hand, and loss or consumption. These forecasts must be time sensitive, and based on whatever sets of planning factors (e.g., FM 101-10-1, JIFFY Wargame results, or new factors) the user wishes. The methodology should generate data for comparisons of projected courses of action, should compare forecasts against current and anticipated resources, and should compare forecasts against actual experience, to improve planning factors over time.

CONCEPTUAL DESCRIPTION OF A RESOURCE PLANNING AID

The concept for a Resource Planning Aid to meet the above requirements begins with the detailed forecasting models being developed at the ADMINCEN and

LOGCEN. The aid would use these models to compute detailed forecasts for each of a series of time intervals specified by the user. For each such interval, it would then aggregate these forecasts by unit in accordance with task organization. It could then convert predicted losses and consumption to terms more useable by tactical planners (such as percentages of remaining assets), and collect the detailed and converted forecasts into groups defined in accordance with commander's guidance. Next, the aid would examine each group in each major category (e.g., equipment) to determine which has the lowest predicted status for each time interval. Finally, it would display results in a systems context, showing the anticipated status of each major component of the unit's weapon systems. The user would have the option to select additional information at any level of detail desired, for his own or any subordinate echelon.

The aid's full data base would contain TOE, status, and planning information about every MOS or SSI and grade (e.g., officer, warrant officer, and enlisted soldier), every fuel-burning item of equipment, every type of fuel, and every type of ammo specified by the commander. However, a more modest version of the aid could be implemented, primarily by reducing the scope of the data base. In either case, maximum utility would require maintenance of data in the data base for one echelon below the lowest echelon for which resource planning would be supported. Generally, data items would be entered at system start-up and then changed infrequently, for example when new equipment entered the inventory of commander's guidance changed.

User inputs would depend upon the user's purpose. For data retrieval and synthesis, menu selections and responses to simple queries would suffice to inform the methodology of the user's desired outputs. Forecasts would require more inputs from the user; however, most of these inputs could also be provided via menu selections and responses to simple queries.

EVALUATION OF THE RESOURCE PLANNING AID CONCEPT

To evaluate the conceptual design of the Resource Planning Aid, a demonstration script was prepared to describe the methodology's potential capabilities and to illustrate sample outputs at various levels of detail. The demonstration script was presented to 87 staff officers in organizations in USAREUR from theater level down to battalion. Their reactions to the aid concept overall and to various specific capabilities were obtained from written responses to a questionnaire and from verbal comments during discussion periods after the demonstration briefings.

Findings from the evaluation showed that overall 57% of the officers regarded the described aid as one needed in the field environment, although, when analyzed in further detail, the response data showed differences between major commands, between echelons, and between organizations which were

statistically significant. At the level of theater, mean officer responses showed the aid to be perceived as moderately useful at a minimum, and close to very useful. These participants regarded it as a needed tool for tactical planning. At one corps, participants regarded the aid generally to have marginal to moderate usefulness, while participants at the other corps reacted more favorably. Similarly, although division representatives overall provided the most favorable responses, participants at one division professed only lukewarm reactions to the methodology, while those at two others viewed it as moderately or very useful. Participants at brigade and battalion generally did not endorse the described aid, but even at these levels, there were notable exceptions to the prevailing views.

Comments from participants in demonstration sessions suggested additional capabilities be included in the methodology, and other uses of the aid. Two related suggestions for additonal capabilities proposed an enemy data base comparable to the friendly data base, for use in computing present force ratios and predicting future force ratios. A variety of other uses were suggested, among them the assessment of medical resource requirements, training programs, and establishing priorities for supplies. General comments centered on the problems of obtaining field communications adequate to support computer systems and the generally perceived unreliability of current planning factors. One participant suggested using wargames to generate improved planning factors, a suggestion that merits consideration.

While views differed among echelons, and even among units at the same echelon, the major conclusion drawn from the evaluation data is that the enhanced capabilities provided by the Resource Planning Aid are needed by tactical units in the field, at least at levels of division and above. The methodology would provide assistance to staff personnel in the reduction and analysis of tactically-related admin/log data, and in their efforts to support tactical decision making and planning.

A subordinate conclusion is that the methodology would have application and utility in other areas of tactical activity. The area cited most often during evaluation sessions was training.

Participants were concerned that field communications could not support the methodology, that planning factors are currently inadequate to compute valid forecasts, and that the methodology might impose an undue burden on the user.

Individual participants generally were consistent in their responses to the methodology's various capabilities, and these responses generally were consistent with their overall reaction to the utility of the methodology.

Finally, the methodology's overall utility (and therefore user acceptance) could be increased by adding capabilities such as those suggested by participants in their verbal and written comments.

RECOMMENDATIONS

SDC recommends that definitive plans for development of a Resource Planning Aid be formulated and implemented. Development of the aid should take an evolutionary approach, beginning with a version more modest than that proposed for the Mid-1980s. By initially reducing the scope of its data base along the lines described elsewhere in this report, an aid could be implemented more quickly and relatively inexpensively. Moreover, this approach would provide fairly immediate assistance to field personnel whose current manual data processing and analysis methods are viewed as inadequate for resource planning tasks. A limited version could be developed that uses current data bases and data collection methods, and that does not depend on anticipated but presently unavailable communications capabilities.

Equally important, a limited version of the aid would permit field experience to guide developers in the evolutionary process leading to more sophisticated and powerful versions. A working--albeit reduced--version could be tested in command post and field exercises, and data could be collected on numbers and types of user interactions. Data could also be obtained on processing times and lengths of user sessions. Learning effects could be studied; error rates and types could be determined. User burden and other features of the methodology affecting user acceptance could be identified. Analysis of these data would provide information to improve the methodology, eventually leading to the version envisioned for the mid-1980s.

During development of the initial version of the aid, serious consideration should be given to suggestions from potential users reported in this document. Two of these suggestions merit particular attention. One is to include a capability to store and process enemy status data, and to generate enemy forecasts for comparison with those generated for friendly forces. This capability could add substantially to the methodology's utility and power. The other is that serious consideration be given to the feasibility of using the DIVWAG wargame in a systematic program to generate improved admin/log planning factors. This approach should help to provide the valid, user-accepted planning factors upon which the effectiveness of the methodology depends.

SDC further recommends that any work to develop a Resource Planning Aid continue to be guided closely by appropriate human factors principles. For example, close attention should be given to making user inputs and interactions as simple and understandable as possible. This approach would ensure greater useability and productivity in the final product, and would do much to ensure user acceptance.

Finally, even the most sophisticated version of the Resource Planning Aid will not meet all of the tactically-related needs of the Personnel Administration and Logistics Elements. Research should continue into these tactically-related functions, and data processing applications should be developed to support them.

A RESOURCE PLANNING AID FOR ASSESSING THE PERSONNEL AND LOGISTICS IMPLICATIONS OF TACTICAL OPERATIONS

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INTRODUCTION

BACKGROUND

The modern Army corps follows doctrinal concepts that have evolved over a period of centuries. Methods of tactical operation derived from these concepts generally have proved successful in battle, sometimes spectacularly so. Nonetheless, there is concern within the Army that these methods will not suffice on the modern battlefield.

That battlefield is immensely more complex than its precursors. Its complexity is partly a result of the variety and intricacy of the weapons provided by modern technology. More importantly, it is also a result of a battlefield "information explosion" rivaling the one cited so often in the civilian literature. Status reports, situation reports, and a growing array of intelligence-gathering devices have created a deluge of information that threatens to engulf the commander and his staff. Traditional command and control procedures, carried out with limited manpower, simply are unable to cope with the situation.

Recognizing this problem, the U.S. Army several years ago began a program to develop a computer system to assist with information processing and management for command and control. The Tactical Command and Control System (TC^2S) has emerged as a conceptual product of that program. The System's purpose will be to provide efficient reception, storage, processing, retrieval, display, and dissemination of tactically-relevant information required by the commander and his staff.

As part of the TC^2S development effort, the Combined Arms Combat Developments Activity (CACDA) has responsibility within the Army's Training and Doctrine Command (TRADOC) for identifying user requirements for the system. Until the reorganization of CACDA about midway through the current contract year, the TRADOC System Manager for the Tactical Operations System (TSM TOS), directed the program to identify these requirements. Since that reorganization, the Command, Control, Communications and Intelligence (C^3I) Directorate of CACDA has assumed responsibility for the program. For the sake of brevity and to avoid possible confusion, the more inclusive term "CACDA" is used throughout this report to refer to the military sponsors of the work reported here.

ARI is providing research support to CACDA as part of the TC^2S development program. Their work has focussed on issues of human performance capabilities and limitations, and on complementing human characteristics by means of automatic data processing (ADP) support to battlefield information management. Under contract to ARI, SDC personnel have been working in this area for the past three years.

In the first year of the contract, SDC performed job and task analyses of the functions performed by commanders and their staffs at the division, brigade, and battalion echelons[1]. These analyses provided data for comparisons of those functions with system specifications for a tactical data processing system. The comparisons in turn guided development of a conceptual outline of computer support for staff operations, which in turn would serve as the foundation for developing materials to train staff members in the use of the computer system. At the same time, these job and task analyses revealed critical command and control functions that are difficult to perform with current manual methods, and were not then supported by current or projected applications. There were 32 such functions in all. Potential computer applications to support these functions provided the basis for the second year's effort.

In the second year, project members screened the potential applications to identify those that supported functions in greatest need of performance enhancement[2]. Personnel attrition prediction and logistics status reporting emerged as functions best meeting the selection criteria. Subsequent work identified the problems inherent in current methods for performing these functions and led to a conceptual description of a potential software application to support them. The application envisions a personnel and weapons system assessment procedure to predict the future status of a division's critical assets and then to validate predictions on the basis of experience. An experiment to evaluate the feasibility and utility of the recommended application yielded data indicating that staff personnel would be able to solve problems significantly more quickly and more accurately using the application than they can using current methods.

OBJECTIVES

A logical extension of the second year's effort was to determine the need for and feasibility of expanding the scope of the attrition prediction and reporting application per se, and from division to corps level. This effort would parallel and augment CACDA's work to identify system requirements for intelligence and operations information processing and management functions at the levels of corps and its subordinate echelons.

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1. Modisette, B.R., Michel, R.R., and Stevens, G.W. Initial Strategies for the Tactical Operations System (TOS) Support of Command and Control Process. Volume 2: Description of TOS Functions for Division Elements. TM-6009/001/00, System Development Corporation, February 1978.
2. Parrish, R.N. and Stevens, G.W. Development of Data Processing Strategies for Potential Application in the Tactical Operations System (TOS) and Other Tactical Data Systems. TM-6257/000/00. System Development Corporation, February 1979.

The general objectives of this contract year were to: (1) develop data processing techniques to enhance information management performance of personnel administration (G1) and logistics (G4) functions directly related to tactical command and control; and (2) to conduct an evaluation of those techniques in terms of their effectiveness in supporting those functions. More specifically, the project sought to:

(a) Analyze the functions performed within corps Personnel Administration and Logistics elements. The initial analysis focussed on attrition prediction and associated status reporting. Nonetheless, the analysis remained alert to other tactically-related functions in these elements that might be in greater need of performance enhancement, and that fell within the scope and resources of the contract.

(b) Either identify an existing or else develop a new automated job aid to improve data processing procedures in the function that most required performance enhancement, and that could be supported with available resources.

(c) Conduct an evaluation of the resulting methodology to determine whether it fulfills the defined need.

ORGANIZATION OF THE REPORT

The remainder of this document is organized into three major sections each of which focuses on one of the major activities undertaken to achieve the above objectives. The first section describes the selection and validation of the job aid that would focus the remainder of the work. Section two provides a conceptual definition of a data processing job aid designed to support that function. The final section documents the results of the evaluation conducted to assess the worth of that job aid, as perceived by prospective users.

SELECTION AND VALIDATION OF POTENTIAL JOB AIDS

PRELIMINARY INVESTIGATION

Any job aids selected for future work would have to meet each of the following criteria. First, job aids must support important, tactically-related admin/log functions. Second, these functions had to be ones for which current manual procedures yield inadequate performance. Third, such aids must captialize on the second year's work. Fourth, these aids must take advantage of, but not duplicate, Army projects planned or currently in progress. Fifth, they must

capitalize on the information processing capabilities of computers planned for corps and subordinate echelons in the mid-1980s. Finally, of course, conceptual development of the job aids must be feasible within the limits of resources available to the contract.

The initial effort began with a review of Army literature related to personnel administration and logistics. FM 101-5[3] and RB 101-5[4] played a significant role in that review, although other documents listed in the bibliography also contributed to this effort. Project personnel extracted general descriptions of basic staff functions from these documents, along with a detailed list of responsibilities for the Assistant Chiefs of Staff for Personnel Administration and Logistics. They eliminated a few functions that clearly did not relate to tactical command and control, such as awards and decorations.

Next, project personnel interviewed officers at Fort Leavenworth whose previous experience included corps-level staff assignments. These interviews proved to be most productive, providing valuable insights into corps-level admin/log functions pertaining to tactical operations. Follow-on discussions with CACDA officers, and their review of the admin/log functions, reinforced the results of these interviews.

These activities revealed three admin/log functions that met the criteria described earlier in this section. Project personnel then developed conceptual descriptions of three potential applications to enhance performance of these functions. These descriptions are presented immediately below.

Resource Planning

Within the G1/G4 elements, status data could be maintained over time for critical MOSs, critical supply items (particularly in classes III, V, VII, IX and float), and on the status of General Support (GS) maintenance. Types of data would include losses, expenditures, assets on-hand, and pipeline availability. Indices would be developed of resource utilization for specified MOSs and critical supply items, and of GS maintenance status. Such indices would help to identify developing critical situations so that resource planners could respond to these situations in a more timely manner.

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3. Staff Officers Field Manual: Staff Organization and Procedures: FM 101-5. Headquarters, Department of the Army, 1972.
4. Command and Control of Combat Operations: RB 101-5. U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, June 1978.

Force Composition Planning

Depending on the Threat force composition and the friendly commander's mission, different Threat weapon systems will be assigned priority as targets. Servicing these different target types may require different combinations of friendly weapon systems. At the same time, differing types or quantities of armament may be required for different target priorities. During planning prior to the start of hostilities, these considerations will affect decisions about force compositions required to counter the Threat, as well as computation of the Required Supply Rate.

Battlefield Dispatch Assistance

Under the Weapon System Replacement Operations (WSRO) concept initially developed at the Admin Center, crews are assigned to major weapons at the corps level. A corps Weapon System Manager then allocates complete weapon systems--and when necessary, individual weapon syste components--to divisions in accordance with G3 fill priorities. In turn, the division Weapon System Manager allocates weapon system resources to battalions in accordance with G3 fill priorities. To provide the greatest percentage of fully operable weapon systems on the battlefield, Weapon System Managers need to know at least the:

(1) G3's fill priorities;

(2) current shortages of weapon systems at the appropriate subordinate units;

(3) current status of replacement weapon systems and components;

(4) maintenance status of major end items; and

(5) status of partial crews and of crewmen returning to duty.

AFT and CACDA representatives approved these descriptions. However, all parties agreed that they should be validated in field settings before any conceptual development began.

FIELD VALIDATION

The field validation had the following purposes. First, the findings of the preliminary investigation needed to be confirmed in a field setting. Second, project personnel needed to ensure that other major areas of interest had not been overlooked. Third, they needed to determine field priorities for further work on the potential applications, because contract resources could not

support development of all three. Finally, to avoid duplication, they needed to determine whether other agencies or organizations had current or planned projects underway in the proposed areas. To fulfill these purposes, the COTR arranged trips to the headquarters of four corps in USAREUR and CONUS, and to the Personnel Administration Center (ADMINCEN) and the Logistics Center (LOGCEN). The COTR tried to arrange trips to the two Centers prior to visits to the corps. However, scheduling difficulties precluded this schedule, and the visits to the Centers occurred after the trips to the USAREUR Corps.

Visits to USAREUR and CONUS Corps

Visits to corps headquarters consisted of two phases, an exploratory visit and an in-depth investigation.

Exploratory visit. The exploratory visits were conducted with 12 principal staff officers (G1, G3[5], and G4) to brief them on the purpose of the visit and of the overall project. The CACDA/ARI/SDC team interviewed each officer separately. The team solicited his reactions to each of the three potential data processing applications in terms of their relevance and utility to his staff section, and their relative priority of need to enhance performance of the functions the job aids would address. Additionally, the team asked each officer to suggest other tactically-related admin/log functions that he judged to be higher in priority of need for performance enhancement. They phrased the question in this way because the preliminary investigation had already indicated that the three proposed functions should have high priority. If the principal officer agreed, there would be little purpose served in identifying less important functions. Assuming that the principal saw merit in the applications, the team also sought his approval to interview subordinate officers for in-depth information regarding each of the functions to be supported by the candidate applications. Finally, team members asked him to comment on attrition prediction in the context of tactical operations. However, the majority of them commented on it prior to this point in the interview, during discussion of the Resource Planning Aid. Thus, their responses to the direct question was generally limited to variations of, "Attrition prediction is important to all three functions. I don't see it as separate."

Exploratory visits were conducted at both corps in USAREUR prior to in-depth investigations in either corps. This schedule was important during the visit to USAREUR; a major function of the exploratory visits was to identify and resolve any conflicts that might exist between the two corps in the perceptions

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5. The purpose of visiting G3 personnel was to obtain observations from tacticians regarding the relevance of the functions addressed by the potential job aids to tactical operations.

of principal staff officers regarding the potential applications. By contrast, the major purpose of the visits to CONUS corps was to obtain information for comparison with that gathered in USAREUR. The CACDA sponsors of the project had stipulated that any job aid emerging from the project would be implemented first in USAREUR. However, data were needed to determine whether changes would be required to adapt the methodology for later implementation in CONUS. Therefore, while visits to CONUS corps were necessary, there was no necessity to complete both exploratory visits prior to starting in-depth analyses.

Results from exploratory visits. In general, corps principal staff officers agreed that all three of the functional areas were important and needed performance enhancement. Their reactions to the proposed job aids are described below.

(1) Resource Planning. The principal officers were nearly unanamous in ranking this function first. One G3 indicated that Force Composition Planning should take precedence, with Resource Planning next. Otherwise, Resource Planning was regarded not only as the most important, but also most in need of performance enhancement.

In personnel administration, the critical information item is unit strength, expressed as a percentage of authorized strength. Unit strength further needs to be broken down by combat, combat support, combat service support categories, and by officers, warrant officers, and enlisted soldiers. In addition, most Commanding Generals are concerned with critical shortages of specific skills. Thus, G1 personnel need a method to combine loss projections with expected replacements, broken down by MOS and grade. They could then identify critical grades and critical skills for use in the tactical planning.

G1 staff members typically do not perform attrition prediction for replacement purposes. The 1st Personnel Command (PERSCOM) provides loss estimates for III, V, and VII Corps. In addition, divisions send personnel requisitions directly to the PERSCOM, which relays them to the Department of the Army (DA). DA then sends replacements directly to the divisions. However, G1 officers stated that they perform attrition prediction (rarely in one corps, but for every mission in two others) for tactical planning purposes. They further pointed out that different forecasting procedures are available (e.g., FM 101-10-1[6], data from the JIFFY Wargame[7], and the Allied Forces Central Europe (AFSCENT)

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6. Staff Officers Field Manual Organization, Technical, and Logistics Data. Headquarters, Department of the Army, FM 101-10-1, July 1976.
7. JIFFY is a computer-supported, corps-level wargame. Interested readers may contact Scenarios and War Gaming Directorate at Fort Leavenworth for information.

Assessment Manual[8]). The same theme was voiced by G4 officers who mentioned consumption rates provided by NATO, USAREUR Headquarters, and the corps. They voiced some uncertainty as to which to use.

The XVIII Airborne Corps differs from the other corps in this respect. Its 18th Personnel and Administration Battalion of their Support Command handles all personnel requisitions and replacements directly with the Military Personnel Center (MILPERCEN). Personnel loss forecasting is performed only for parachute operations, and then only for jump victims.

They perform no forecasts for combat losses, arguing that FM 101-10-1 is obsolete. However, the G1 indicated that his element probably would use a better attrition prediction routine if it were available.

In logistics, the critical item of information depends on current or expected shortages. But whatever the item, logistics staffs need detailed information. Such information is not always necessary for briefing the Commanding General. If no problem exists with a class of supply, that fact will usually inform him adequately. However, when problems do exist, the General's questions may be quite specific. Days of supply and tonnages are not sufficient; what is needed is, for example, how many 155 rounds are available, and where are they? The G4 needs a method to project asset usage based on recent data, so that he can tell the commander, for example: "General, our projections show that we'll be out of 155 rounds in two days, and we're not going to receive any new 155 rounds for three days." Given this information, the Commanding General may begin to look for ways to attenuate the intensity of the battle and thereby conserve assets, or search out alternative supplies.

Such a trend routine would have to include information about maintenance, not merely at the GS level (which the G4 currently gets from the Support Command), but also at the Direct Support (DS) and organization level (which he doesn't get at present). Further information about replacement assets would be needed to provide accurate trends.

(2) Force Composition Planning. The principal staff officers did not entirely agree on this function. As noted above, one G3 regarded it as the most important. G1 officers did not perceive much involvement on their part, except as task organization affects priority of replacement. One G4 was concerned only about the quantity of consumables that are being tracked. In fact, this officer stated that, given an effective resource planning aid, he could carry

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8. The officer who provided this information did not have a reference, and project personnel have not located it at Fort Leavenworth.

out his responsibilities in regard to this function manually, and without difficulty. Other G4s expressed little concern with the function.

(3) Battlefield Dispatch Assistance. As described earlier, this potential application is grounded in the concept of WSRO, which was described to the Corps sometime before the CACDA/ARI/SDC visit. Nearly all the principal officers applauded the concept in principle. However, because current methods used to "marry up" equipment and crews differ substantially from those described in WSRO, they all stated that the concept is unworkable in practice, given its present form. Nonetheless, one G4 rated this application second to resource planning. He pointed out that matching major weapons and crews is an important function, however it is performed. He further noted that the function is not totally dependent on WSRO, and that if its performance could be enhanced via automatic data processing, then it should be done independently of WSRO.

(4) Other Functions. The principal staff officers interviewed at the corps did not suggest any other functions that would be appropriate for support by TC^2S.

All of the principal officers seemed greatly interested in the team's mission, though several expressed varying degrees of scepticism about a computer system dependent on contemporary Army field communications. To paraphrase one principal staff officer's remark: speed-of-light computations would be great, but those computations will be performed on pony express data if TC^2S uses current communications. Indeed, a general problem complicating all personnel administration and logistics functions is timeliness of data. The principal officers in both USAREUR and CONUS attributed this problem to data transmission delays caused by deficiencies in admin/log communications net. Another general problem is accuracy of data. The principal officers attributed this problem most often to the confusion that frequently accompanies changes in task organization. Several officers observed that these changes make very difficult their tasks of keeping track of people, equipment, and supplies. One officer commented that subordinate units frequently report task organization erroneously. More often, however, the personnel and logistics assets themselves are reported erroneously. Evidently, multiple reporting of the same assets is not uncommon as units are attached and detached. Sometimes, the resulting errors are obvious, as when the roll-up of reports shows a division reporting more tanks than its TOE authorizes. Other times, they are more subtle, and therefore more difficult to detect. A consequence of the timeliness and accuracy problems is that admin/log personnel spend so much time collecting and verifying data that little time remains for analyzing them.

G3 personnel generally agreed on the need to improve admin/log data processing capabilities. Their growing awareness of the importance of combat service support to tactical operations is exemplified by the following observations.

One principal officer stated bluntly, "Log will drive the next war." Another stated that one of his responsibilities was to create an environment in which the G1 and G4 staff would have the capability to assemble, forecast, and present combat data that are essential to tactical planning.

In-depth investigations. After the CACDA/ARI/SDC team completed the exploratory visits, team members returned to each of the corps headquarters to examine in greater detail the functions discussed during the exploratory investigation. To accomplish this purpose, they conducted task analyses during interviews with action officers in the G1 and G4 elements. For each function, they interviewed the officer who was most conversant in the functional area of interest. Each officer was interviewed to determine his role in each of the application-related functions, the inputs he required and their sources, the methods he used for processing data, and the outputs of his efforts and their recipients. He was also asked to describe any difficulties he had in obtaining or processing the data. This information was collecting using specially prepared data collection forms (Appendix A).

In addition to these visits, the team members visited one mechanized division. They interviewed the G1 and G4 principals, their action officers, and staff officers of the Division Support Command. The purpose of this visit was to discuss the potential applications generally, but in particulat to discover how crews and equipment are "married up."

In-depth investigation results. The in-depth investigation with staff action officers yielded a considerable volume of data pertaining to the potential data processing job aids. In addition, the action officers and several principals described a number of individual tactically-related admin/log requirements. These requirements fall beyond the scope of this contract effort, and therefore will not be described here. However, because they may interest CACDA representatives responsible for overall battlefield automation, they are described in Appendix B. Information regarding the candidate applications is discussed immediately below.

Resource Planning. At present, resource planning is done entirely with manual methods, and both principal and action officers stated that they can't perform the function as well as they'd like. In personnel planning, as noted earlier, the corps G1 is no longer responsible for attrition prediction for personnel replacement purposes. In one corps, loss estimates have not been computed

for some time. When they were computed in past exercises, methods in FM 101-10-1 were employed. In other corps, loss estimates are computed for each exercise. One corps uses FM 101-10-1 and resulting estimates are adjusted according to the judgement of the officer performing the computations. Another corps has used several procedures. Most recently, the AFSCENT Manual was used; however, FM 101-10-1 and JIFFY wargame results have been employed. Both principal and action officers expressed a desire for better methods of loss estimation. Staffs at corps and subordinate echelons would not use such estimates for replacement planning (that currently being a PERSCOM function). However, they would like to be able to combine loss estimates with projected replacements and thereby inform the commander that, at a given day in the future, he can expect his personnel strength to be a given value. They would like to be able to do this by officer, warrant officer, and enlisted grades, and by combat, combat support, and combat service support categories.

In logistics planning, action officers believe that a resource planning aid would greatly facilitate reallocation of forces, assist in allocation of replacements, and help to determine trends in asset usage. One action officer stated that their greatest problem is determining trends. One corps computes trends using a method of weighted averages; others don't even attempt to compute them. Principals and action officers alike stated that trend analysis would be invaluable for their planning efforts.

As presently performed, resource planning begins with the receipt of status data, either from major subordinate commands or from the Support Command. These data are posted manually to formatted charts, and in some cases to "spread sheets" prepared especially for each exercise and discarded afterward. Additionally, data are received from USAREUR regarding replacement equipment and new supplies, and from GS maintenance regarding equipment returning to service. These data are also posted to charts; all types of data are posted for each of the corps' major subordinate commands.

When all data have been received and posted for the given reporting period, they are consolidated. This process involves only simple addition; for each item of equipment, POL, or ammo that is tracked, the sum is computed for all of the major subordinate commands. The total includes any assets delivered to the unit during the reporting period.

The corps differ somewhat in their processing of the corps totals. However, at least one corps computes each of the following:

a. % Fill for Class VII = number on hand ÷ number authorized x 100

b. Days of Supply = number of pieces (e.g., rounds, gallons) x rate of usage

c. % OR for Class VII = number OR ÷ number authorized x 100.

d. Overall status of each Class (expressed in color code) obtained by comparing percentage available to percentage categories.

e. Trends over time. For each day, compute total number of rounds, or gallons, or systems expended to data ÷ number of days to date.

f. Compare trend data to Corps Controlled Supply Rate (CSR) to determine whether units are expending more of the commodity than they're allotted.

Once data processing is completed, reports are prepared for NATO, CENTAG, and USAREUR, and charts are prepared for the Commanding General's briefing.

Force Composition Planning requires relatively little data processing, and could be supported by a Resource Planning Aid. Battlefield Dispatch Assistance, as described earlier, was rejected as unworkable. Because its underlying concept, WSRO, is being revised at the LOGCEN, a new Battlefield Dispatch Assistance scheme will have to be devised when the concept is completed. For these reasons, and because the two job aids are not germane to the remainder of this report, results of the in-depth investigation into them are not presented here.

The in-depth analyses performed in III Corps and XVIII Airborne Corps in CONUS were intended primarily to determine whether significant differences existed between these corps and those in USAREUR in respect to the potential applications. In general, no such differences emerged from the analyses. The Commanding Generals are briefed on somewhat different data items, using differently formatted briefing charts. Nonetheless, procedures for performing the various functions are sufficiently similar that existing differences should have relatively little impact on the selected application. The flexibility initially planned for each of the three potential applications should accomodate any of the corps that were visited.

Visits to ADMINCEN and LOGCEN

The COTR arranged interviews at the two Centers with personnel from all Directorates whose work might have implications for this project. Though they are working on a considerable number of projects, only two of them are relevant to this contract, one at each Center.

Administration Planning Factors Development. The original impetus for this program apparently came from the Concepts Analysis Agency (CAA). They needed an improved attrition prediction model for their effort to develop Wartime Requirements for Ammunition, Materiel, and Personnel (WARRAMP). Program

personnel at Fort Benjamin Harrison developed what has come to be called informally the "Fort Ben Model." The model computes replacement requirements by 3-digit MOS and grade as follows:

Req. repl. =	Gross battle & non-battle casualties	x	Branch functional area vulnerability factor	x	3-digit MOS/SSI vulnerability factor	x	Grade factor density

Note that the Fort Ben Model incorporates gross battle and non-battle casualties, which typically are computed using FM 101-10-1. However, during interviews with principal and action officers in Europe, no one expressed satisfaction with the FM 101-10-1 planning factors. The ADMINCEN is aware of the problem and has undertaken to upgrade these factors. They have formulated the following prediction model:

Replacement forecast by MOS and grade	=	Unit strength	x	Branch/functional area vulnerability factor	x	3-digit MOS/SSI vulnerability factor	x	Grade factor by density

x Operational factors

For each term in the model except unit strength, project personnel are working to determine the probability of a casualty. When the probabilities are combined with unit strength in the model, the result is an attrition forecast for a specific MOS/SSI-grade combination. Although this project is still in progress, it has clear implications for SDC's work. As noted earlier, the field validation revealed that attrition prediction would be an integral part of any of the three proposed job aids. Thus the project at the ADMINCEN will result in a model that could be used by a job aid methodology. However, the above model generally would not be suitable for application to tactically-related applications. The model generates a separate forecast for each combination of MOS/SSI and grade. These detailed forecasts are appropriate for replacement planning purposes. For planning purposes related to tactical operations, additional processing would be required (discussed later in this report). Still, the model could provide detailed forecasts as inputs to be manipulated by the Resource Planning Aid. These manipulations will be described later.

Planning Factors Management (LOGCEN). This LOGCEN project is concerned with two issues: an improved model for forecasting equipment losses (fuel and ammo consumption models are considered adequate); and improved planning factors for all classes of supply except I and VI. At the time of SDC's visit to the LOGCEN, project personnel had completed planning factors for Classes II through V and were beginning work on a Class VII forecasting model and associated planning factors. The models for forecasting fuel and ammo consumption are straightforward, as described below.

(1) Fuel consumption. Formulas for fuel forecasting depend upon the type of equipment. For all equipment except tracked vehicles, the formula is:

Bulk fuel requirement for 1 day	=	End item density	x	Consumption rate in gal/hour or gal/mile	x	Usage rate in hours/day or miles/day

For tracked vehicles, the formula is more complicated:

Bulk fuel requirement for 1 day	=	End item density	x	[(Idle consumption rate in gal/hour	x	Idle usage rate in hours/day)	+
				(Cross country consumption rate in gal/hour	x	Cross country usage rate in hours/day)	+
				(Secondary road consumption rate in gal/hour	x	Secondary road usage rate in hours/day)]	+

(2) Ammunition consumption. Consumption forecasts for all ammo types are computed by the same formula:

Ammunition requirement for 1 day	=	End item density	x	Rate in rounds per weapon per day	x	Level of combat intensity

The implications of this LOGCEN project for the SDC contract are clear. Officers at four corps headquarters generally agreed that they need better ways to forecast attrition and consumption of supplies, and that a forecasting capability must be an integral part of any of the three potential job aids. As with the ADMINCEN's model, the LOGCEN models generate discrete, detailed forecasts. Thus, the models could provide inputs to a job aid requiring equipment loss and fuel and ammo consumption factors.

SUMMARY AND RECOMMENDATIONS

At the conclusion of the activities described above, the findings were presented to CACDA, and ARI representatives. These findings are summarized as follows.

(1) Corps staff principal and action officers agreed that the potential data processing job aids described earlier address admin/log functions that relate directly to tactical command and control.

(2) The officers generally believed that the functions to be supported are appropriate for inclusion in tactical command and control systems.

(3) They indicated that performance deficiencies exist in each of the functions to be supported by the job aids, and that enhancing their performance is highly desirable.

(4) The data suggest that Resource Planning is the most important of the three functions, and the one most in need of performance enhancement.

(5) The data indicate that, although both important and useful, Force Composition Planning is not a major concern of the admin and log elements. Further, the function involves relatively little data processing, and could be supported effectively, given a properly designed Resource Planning Aid.

(6) Corps staff principal and action officers rejected Battlefield Dispatch Assistance because an underlying concept of the aid, WSRO, is unworkable as presently conceived.

(7) On the basis of information gained from the ADMINCEN and LOGCEN, project personnel concluded that forecasting models being developed at the two Centers could provide inputs to any of the three potential job aids.

(8) Because SDC would not have to devise improved forecasting models, project resources would be adequate to pursue work on one of the proposed job aids.

Based on these findings, SDC recommended that the remainder of the contract year be devoted to developing a conceptual methodology for a Resource Planning Aid. After discussion, CACDA and ARI representatives agreed with this recommendation.

USER NEEDS IN RESOURCE PLANNING

General Needs

Following the decision meeting of CACDA, ARI, and SDC representatives, project personnel began work to identify user needs in resource planning. Two general but very important needs emerged, from both the review of Army literature early in the contract year and from the validation data. First, the staff must support the tactical decision making process by providing input to the commander's estimate of the situation. Second, the staff must support implementation of the commander's concept after his decision is made.

The commander's tactical decision process. FM 101-5 describes the commander's tactical decision process; this description is amplified in RB 101-5. Figure 1 presents a highly simplified conceptual model of the process. Although the model appears accurate in light of descriptions in the cited sources, no claim is made here that it describes the process in complete detail. For example, no attempt is made to model the manner in which the commander analyzes the mission. Also, "assess situation" obviously encompasses a multitude of activities. However, the model does show those points at which staff members (admin and log officers in particular) provide inputs to the process.

Analysis of the model reveals that five basic data processing tasks are required to support preparation of admin/log inputs to the commander's decision process. They are described here in order of complexity. (1) Data collection provides the data base needed to develop information for the commander's consideration. (2) Data retrieval permits the user to obtain selected data items or the results of more complex data processing tasks. (3) Data synthesis reduces data to forms suitable for other processes, or for presentation. (4) Forecast generation provides information about the expected future status of the unit to help the commander assess the situation and analyze tactical alternatives. Finally, (5) forecast comparison provides information to help the commander evaluate the relative costs of his tactical alternatives.

Implementation of the Commander's Concept

Once the commander has made his tactical decision and formulated his concept of operations, admin/log officers must plan for combat service support to the operation. This planning must include allocation of CSS units to support maneuver units in the case of corps and division, and anticipation of shortfalls at all levels with which this project is concerned, along with procedures to overcome or compensate for them. To accomplish such tasks, admin and log personnel require status information and forecasts of losses and consumption. These requirements translate into a need for data collection, data synthesis, data retrieval, and forecast generation. The fifth data processing task noted earlier, forecast comparison, does not enter into implementation of the commander's concept per se. However, admin and log personnel do require a capability to compare forecasts with available and expected assets.

Specific Needs

The admin or log officer preparing to support his commander's decision process or to support implementation of his commander's concept would be the direct user of the Resource Planning Aid methodology. His specific needs, derived from (1) the data collected in USAREUR, (2) the above analysis, and (3) appropriate human factors principals, are discussed below, along with the requirements for the methodology that attempts to meet those needs.

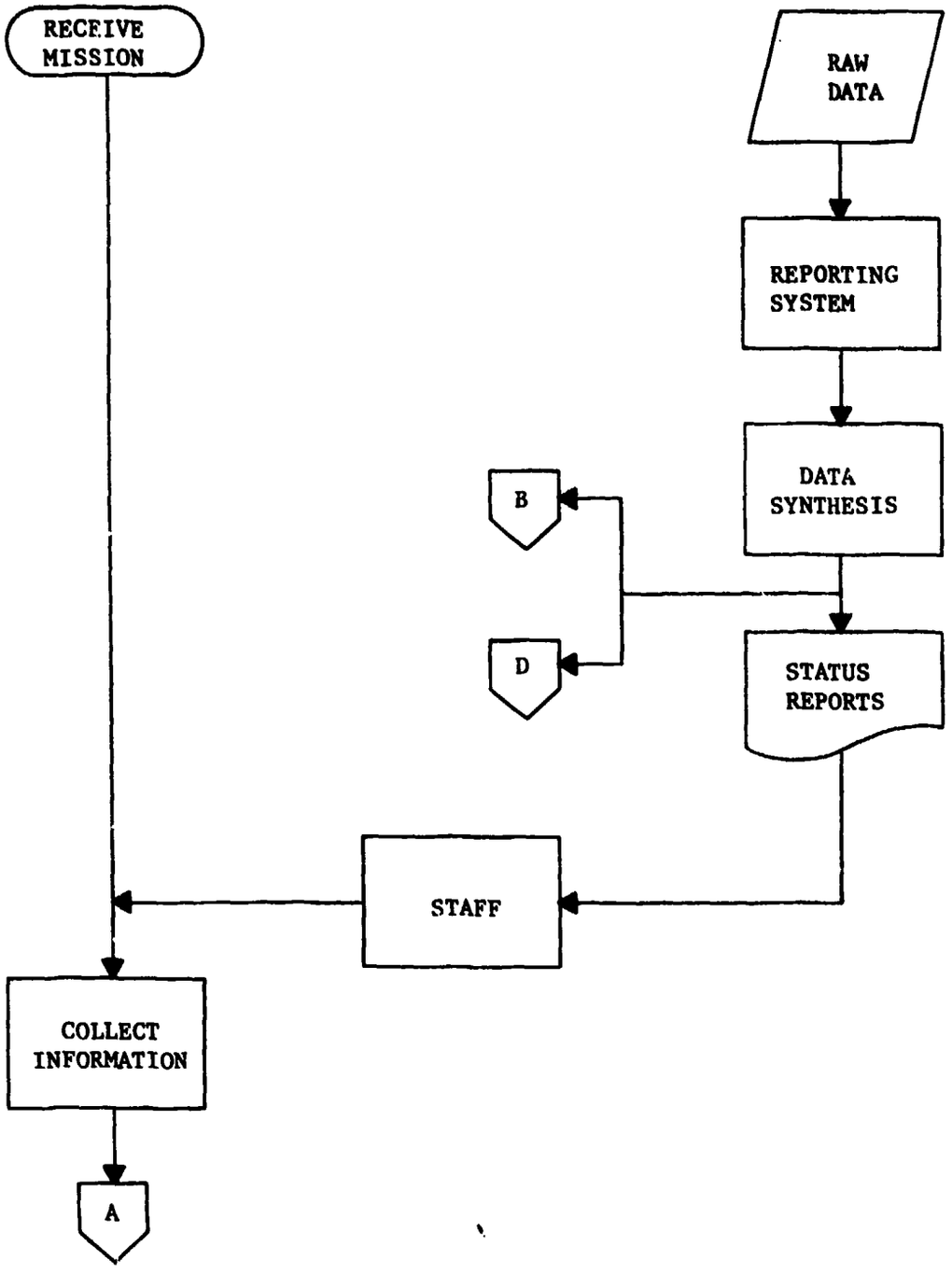

Figure 1. Simplified conceptual model of the tactical decision process.

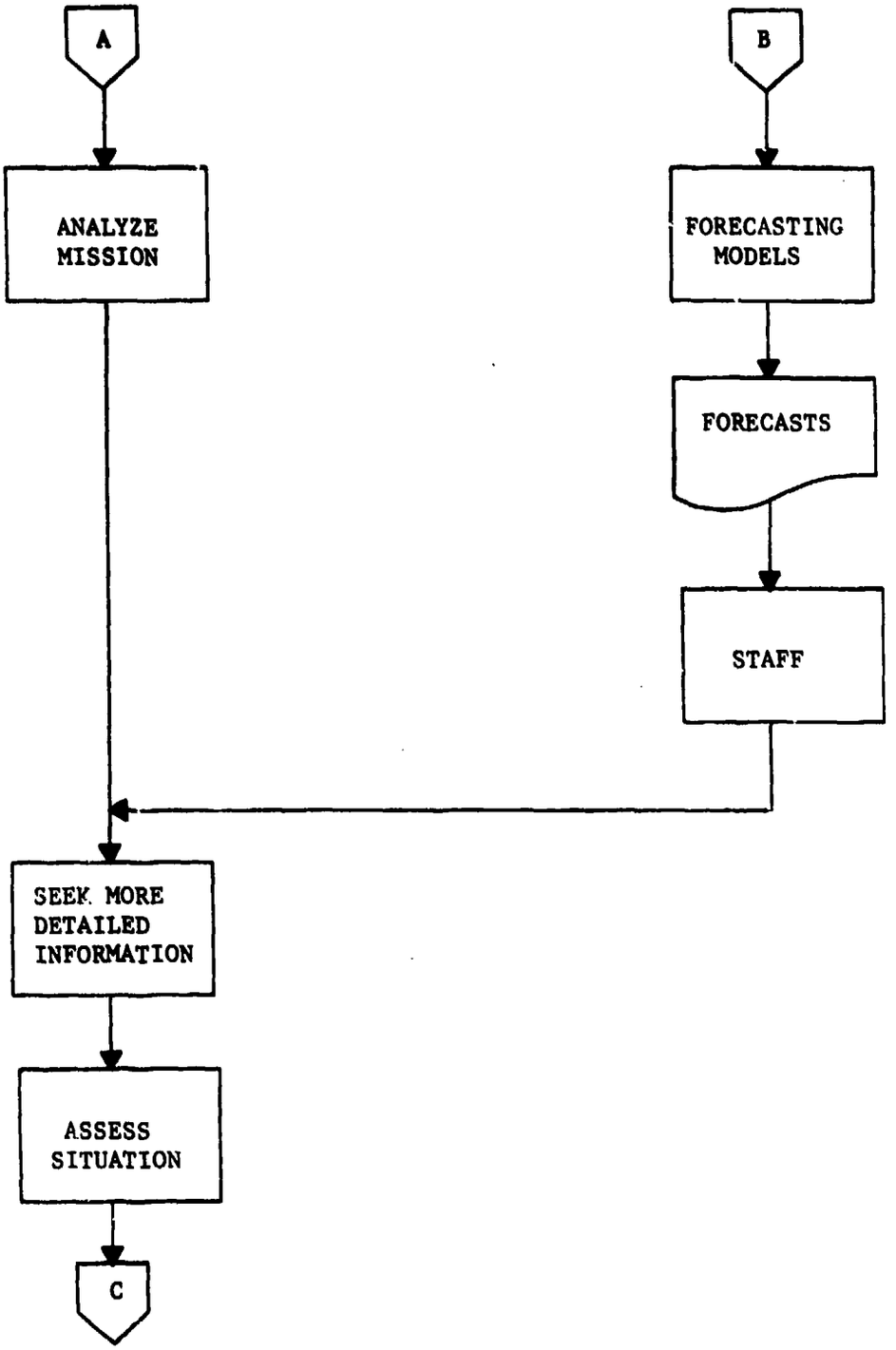

Figure 1. Continued

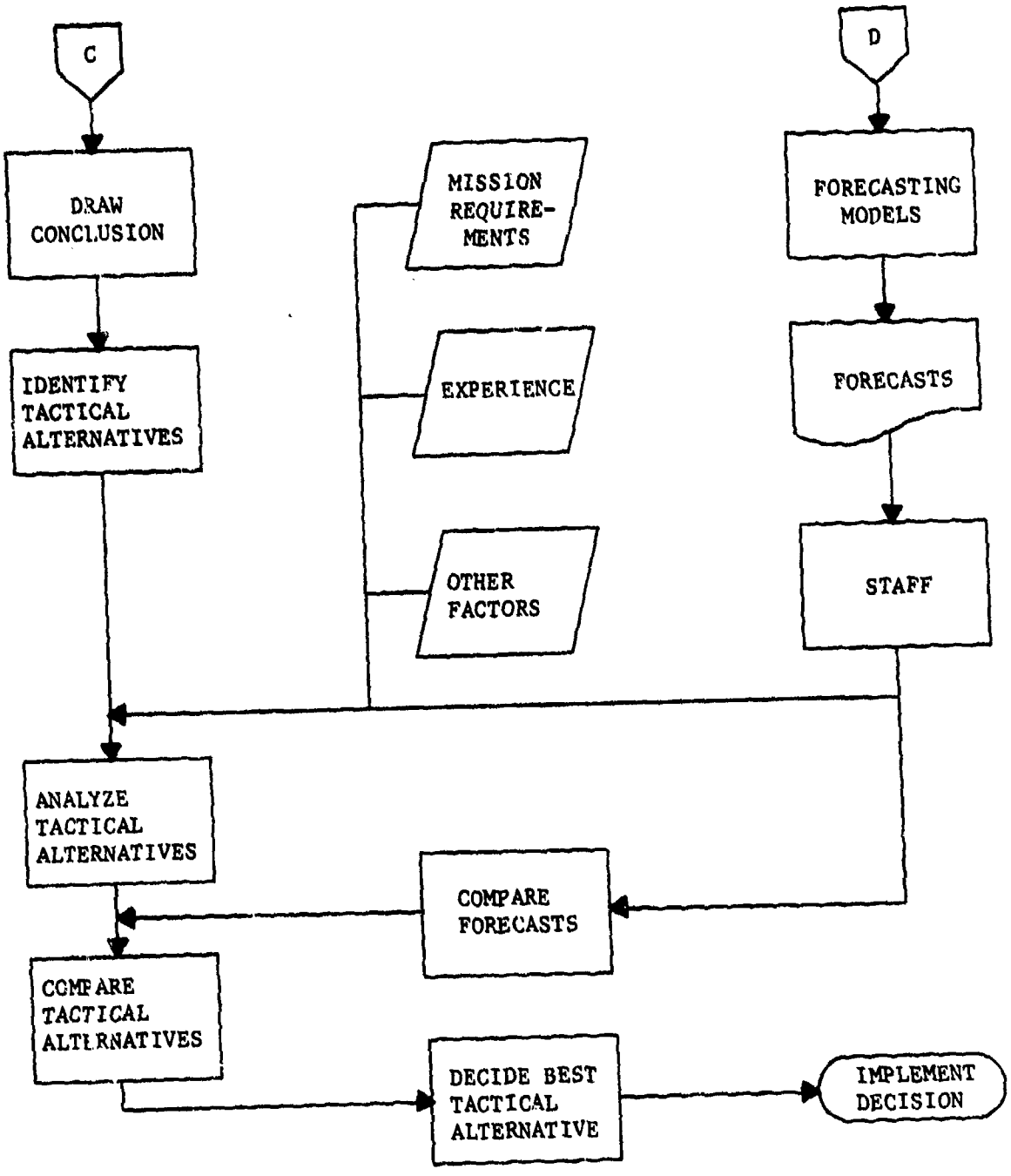

Figure 1. Continued

First, the required raw data must be obtained. The methodology would not contribute to data collection, since that task is a function of the communications system. Rather, the methodology would serve as a reception point and processor of raw data. Raw data requirements are discussed later in this section, under "Data Base Considerations." Having obtained the data, the user needs the capability to retrieve, not only raw data, but also the results of other data processing procedures. Thus, data retrieval must be sufficiently flexible to retrieve any specific item of raw or computed data. However, this requirement does not translate to a requirement to output every datum and every computed result. The user should not receive a stack of printouts or a screen packed tightly with information, through which he must search to find what he needs. Instead, output must be under user control. He should be able to specify which items he wants; then the machine, rather than the user, should search the contents of memory and extract the desired items.

The user also needs a capability to reduce data, and to synthesize it. For example, if he wishes information about personnel or supplies at corps level, the machine should roll up data from lower echelons to fill this need. Further, the methodology should have the capability to aggregate data into groups under user control. For example, commander's guidance may define "tanks" to be M60A1s, M60A2, and XM-1s. Then, further guidance may define "combat systems" to be tanks, TOWs, APCs, and attack helicopters. The methodology must then be able to aggregate data for tanks and weapon systems. That a parallel requirement exists to provide data for personnel groups should be obvious. Again, output must be under user control; a user who needs data on "combat support" soldiers, for example, should not receive data for all the personnel groups defined in accordance with commander's guidance.

As noted above, the user needs forecasts to support the commander's assessment of the situation and his analysis of tactical alternatives. These forecasts must be provided at whatever level of detail is required. The methodology must be able to produce specific forecasts for individual equipment items or MOS/SSI-grade combinations, for equipment or personnel, equipment, fuel, and ammunition. Moreover, it must be able to produce these forecasts for any unit or aggregation of units specified by the user. Additionally, these forecasts must incorporate the effects of incoming personnel or supplies as well as anticipated losses, so that they will reflect as accurately as possible the future status of the unit. Forecasting routines should also have flexibility to present results either in terms of losses or consumption of supplies, or in terms of remaining resources. Further, the methodology must generate time-sensitive forecasts. That is, a projected course of action may include critical subordinate objectives that must be reached by a certain time, or defended for a specified period, if the mission is to be accomplished. Or an operation may be broken into specified time intervals for some other reason. The methodology must tailor forecasts to fit these time intervals, rather than generating all forecasts in terms, say, of days. In addition, the methodology

must have the capability to use different sets of planning factors. For example, the user should be able to select from sets of factors from FM 101-10-1, JIFFY Wargames, the AFSCENT Assessment Manual, or eventually new factors from the ADMINCEN's and LOGCEN's planning factors projects described earlier. Finally, he should have the capability to change planning factors at will, so that he can play "what if" games and explore contingencies.

Also as noted above, the user needs to provide comparisons of the relative admin/log costs of courses of action to support the commander's comparisons of his tactical alternatives. Valid comparisons of this kind do require the best available, but they also require extensive human judgement, experience, and intuition. The methodology should support the human comparison process by providing the required data. In the same way, it should support two other user needs in the area of forecast comparisons. One is the need to compare forecasts of losses with available and anticipated resources. Indeed, the capabilities specified above to incorporate anticipated replacement and resupply would generate outputs that implicitly supported comparisons of this type. The other need is to compare forecasts with actual experience. To support this need, the methodology should accept new status data as the battle progresses and compute deviations between actual and predicted status. In the short term, the methodology could use these deviations to produce new temporary factors for modifying subsequent forecasts, if the user wished. Over a longer period, accumulated experience would guide the development of new permanent factors.

In addition to the needs directly associated with data processing tasks described above, the user has some general needs that should also be fulfilled. First, input requirements imposed on the user must be minimized by using machine inputs to the methodology whenever possible. Those inputs that must be entered by the user should be guided by simple, clear, easy-to-follow directions. Second, having entered his initial inputs, the user should be able to change one or more of them while playing "what if" games without having to re-enter those inputs that he doesn't want to change. Third, the user's needs for control of outputs and for exploring contingencies through "what if" games indicates a requirement for an on-line, interactive capability. Fourth, potential users indicated a need for optional hard-copy, obtainable without interrupting a task in progress. Finally, because time-sensitive forecasts frequently are presented most intelligibly in a graphic format, a graphics capability would be a requirement.

CONCEPTUAL DESCRIPTION OF A RESOURCE PLANNING AID

The methodology for a Resource Planning Aid described here was designed to fill the above user requirements in a systems context, beginning with capabilities presently being developed at the ADMINCEN and LOGCEN. Their forecasting models and planning factors produce highly specific and extremely detailed forecasts; for example, the ADMINCEN model yields a forecast for a single MOS/SSI-grade combination. While such forecasts are essential for replacement and resupply purposes, they satisfy only one of the user needs outlined above. For tactical planning purposes, these detailed forecasts must be computed for successive time intervals, and then for each interval aggregated in accordance with projected task organization, converted to terms of expression commonly used by planners, collected into groups defined by commander's guidance, and displayed in formats consistent with those routinely used in tactical planning.

SDC also conceived the Resource Planning Aid in light of current Army projects to improve field communications, computing facilities, and planning factors. In designing the concept, project personnel planned for the mid-1980s, when these projects might be expected to have borne fruit. Thus, SDC assumed that (1) battlefield communications would have improved sufficiently to permit timely and accurate data transmission; (2) devices such as the Division Level Data Entry Device (DLDED) would be available to transmit data directly to division level; (3) an electronic interface would exist between division and higher echelons; (4) computing machinery of sufficient size and sophistication would be available to divisions and corps to support the methodology; and (5) that reasonable and valid admin/log planning factors would be available.

Until these assumptions are realized, the methodology described conceptually below could not be implemented at the level of detail and precision envisioned here. However, if necessary, the methodology could be modified, primarily by reducing its precision, to employ the data base, communications, computers, and planning factors available to corps and subordinate echelons today. The trade-offs involved in such a modification occur primarily in the methodology's data base, and are discussed later, under "Data Base Considerations."

DATA PROCESSING METHODOLOGY

Descriptions of data retrieval and synthesis capabilities are deferred to the end of this section, because these relatively simple capabilities can most conveniently be described in connection with input requirements (see "User Inputs"). Figure 2 summarizes the forecasting procedure.

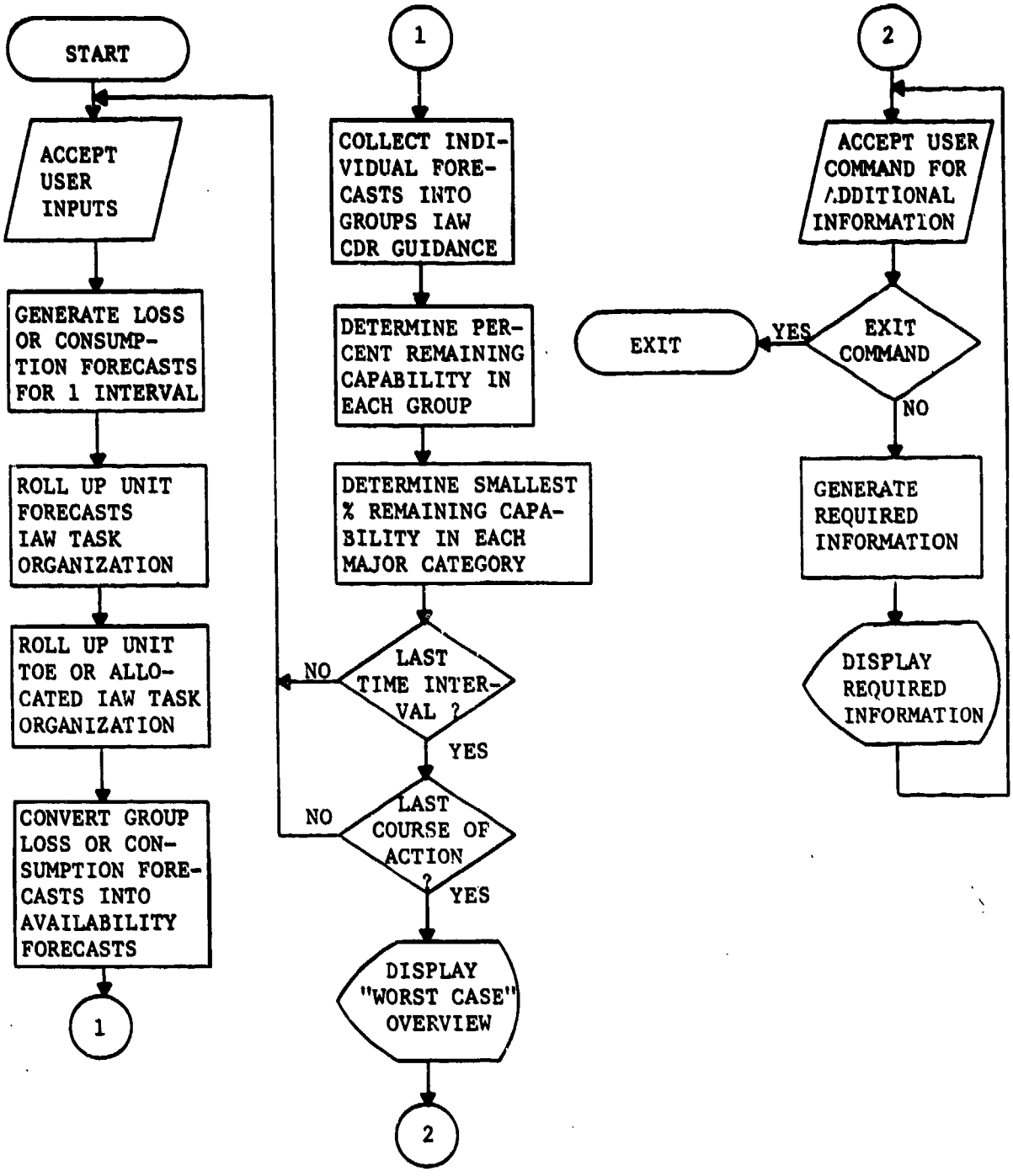

Figure 2. Simplified flow chart of the Resource Planning Aid's forecasting methodology.

Loss and Consumption Forecasts

The methodology would use formulas and planning factors developed in ADMINCEN and LOGCEN projects described earlier to generate discrete loss and consumption forecasts for each unit at the lowest echelon for which data are maintained in the data base. The result of each discrete computation would be saved in temporary storage for the methodology's use later. Indeed, the results of all computations must be saved, whether for these individual forecasts or for the various aggregations described below, in order to satisfy the user's need for information at different levels of detail.

Personnel. The methodology would generate a separate personnel loss forecast for every combination of grade and MOS or SSI in each lower echelon unit, using the ADMINCEN model and factors. This procedure involves a simple multiplication of the probability of a casualty for a particular combination by the present-for-duty strength of that combination. The computation would be performed for every such combination of grade and MOS or SSI in each of the lower level units.

The needed probabilities are not yet available from the ADMINCEN. However, methods exist for obtaining probabilities from published data that could be used until the Administration Planning Factors project is completed. One such method is described in Appendix C. Also, the possibility must be recognized that generating forecasts for the hundreds of combinations of grade and MOS or SSI might prove to be too time-consuming for computers presently available to tactical units. In that case, discrete forecasts might be limited to combinations of grade and branch. If, for example, three grades (officer, warrant officer, and enlisted soldier) and fifteen branches were involved, the number of discrete forecasts required would be reduced to only 45.

Fuel. According to information from the LOGCEN and Army literature, fuel consumption is determined by one of two parameters: (1) the number of miles the machine may be expected to travel or (2) the number of hours it may be expected to operate in a day. For a wheeled vehicle, fuel consumption is computed by the number of miles traveled times the number of gallons of fuel consumed per mile. For an item of stationary equipment or for an aircraft, the computation is number of hours operated times the number of gallons consumed per hour. Fuel consumption for a tracked vehicle is also computed as number of hours times number of gallons per hour. However, in the latter case, the total number of hours must be divided into hours idling, hours traveling cross-country, and hours traveling on secondary roads.

For each line item in the data base for maximum precision, every fuel burner in the corps would be included; see "Data Base Considerations" later in this section, the methodology would first compute fuel consumption for a single item of that equipment. It would then multiply that result by the density of that

item in the lower level unit. The methodology would repeat this procedure for every line item in each of the parent unit's lower echelon units.

Ammunition. The number of ammunition types for which discrete forecasts would be generated would depend on the individual commander's guidance. However, 105mm tank, TOW, VULCAN, CHAPPARAL, and 155mm and 8" howitzer ammo probably would be included at the minimum. The procedure would be the same for each. That is, for each ammunition type, the density of the equipment firing that type of ammo would be multiplied by the daily firing rate.

Equipment. Equipment losses would be forecast only after fuel and ammo consumption had been forecast. The reason for ordering the computations in this manner is that fuel and ammo consumption depend on density. In effect, the methodology would assume by default that equipment available at the beginning of a time interval remains available throughout that interval. Normally, the planner cannot specify the points during an interval when forecasted losses will occur. In the extreme case, they might all occur at the end of the interval. Thus, the most conservative course would be to assume that all equipment available will continue to consume fuel until the interval ends. However, the methodology would have the capability to allow the user to override this default and enter a different assumption.

For each equipment item, the number of items operationally ready would be multiplied by the particular loss factor for that item. The result would be subtracted from the number of items operationally ready at the beginning of the interval to obtain the number operationally ready at the beginning of the next interval. This procedure would be repeated for every item associated with the lower level unit. Examples of individual loss and consumption forecasts are shown in Appendix C.

Roll-up. After the discrete forecasts were generated for personnel, fuel, ammo, and equipment, the methodology would roll them up to produce higher-echelon forecasts. The extent of this roll-up would depend on the user's own echelon and purposes. For example, imagine that data were maintained in the data base for the battalion level. A brigade-level user might wish to retain the battalion identities in the forecasts, or roll them up to obtain a brigade forecast, or both. Similarly, a division level user might want battalion, brigade, or overall division forecasts, or all three. Thus, the methodology would include the capability to generate forecasts for any individual unit or echelon, or combination of units or echelons the user may desire. Any roll-ups required would be guided by the task organization planned for the particular course of action for which forecasts are being generated. After the loss and consumption forecasts were rolled up, unit TOE data for personnel and equipment and allocations of fuel and ammo would similarly be rolled up, guided again by task organization.

Conversion to Availability Forecasts

To provide information expressed in terms normally used in tactical p.anning, the individual loss and consumption forecasts would next be converted to "availability forecasts." First, present-for-duty or number available or operational would be extracted from the data base for each MOS/SSI-grade combination and item of fuel, ammo, and equipment. To this value would be added the number expected to be gained during the time interval for which the forecast was being generated. Then, the number forecasted to be lost or consumed would be subtracted. The result would be an individual availability forecast for each MOS/SSI-grade combination and item of fuel, ammo or equipment, showing the unit's predicted status.

Collection to Groups

The methodology would next collect individual availability forecasts into group availability forecasts, using group definitions formulated in accordance with current commander's guidance. The procedure would consist simply of summing the appropriate individual availability forecasts. Additionally, the appropriate unit TOE values and fuel and ammo allocations would be summed to obtain group authorizations.

Computation of Predicted Remaining Capability

Next, the methodology would convert these group availability forecasts to percentages of remaining capability. It would do this by dividing the availability forecast by the group authorization and them multiplying the quotient by 100. This computation would be performed for each of the groups previously defined. Expressing group availability forecasts as percentages of remaining capability would permit the user to compare qualitatively different forecasts. For example, a comparison of number of tanks with number of 105 rounds would be uninformative at best, and misleading at worst, because 100 tanks, say, means something vastly different from 100 rounds of 105 ammo. Convering them both to percentages expresses the two capabilities in the same unit of measure.

"Worst Case" Computation

For reasons discussed shortly, under "Outputs," the methodology would then compare the groups within each of the major categories of personnel, fuel, ammo, and equipment. For each of these major categories, it would determine which group had the smallest percentage of remaining capability of all the groups in that category, and flag that group. For example, suppose that personnel MOS/SSI-group combinations had been grouped into a three-by-three

matrix defined as officers, warrant officers, and enlisted soldiers, and as combat, combat support, and combat service support. Suppose further that group forecasts for percentages of remaining capability had yielded the (arbitrarily chosen) values in Table 1. Clearly, the group defined as Combat-Enlisted Soldiers would have the lowest percentage of remaining capability of the nine groups in the major category of personnel. Thus, the methodology would flag that group as the "worst case" group for personnel. Note, however, that the "data" in Table 1 represent group percentage forecasts for only one time interval. As replacements were projected to arrive and additional losses occur under perhaps different conditions, the "worst case" for personnel might be a different group in the next interval.

Table 1. Percentage of Remaining Capability from Hypothetical Forecasts for Personnel Groups

	Officers	Warrant Officers	Enlisted Soldiers
Combat	74	75	72
Combat Support	78	78	76
Combat Service Support	80	81	79

Iteration

The processing procedures described above represent computations performed for only one time interval. If only one interval were of interest, then the methodology would proceed to the next step. More commonly, however, a projected operation would be broken into several intervals, and the user would be concerned with all of them. In these cases, the methodology would repeat all the computations for each interval, iterating through the sequence of procedures until forecasts had been generated for all intervals, thereby satisfying the requirement for time-sensitive forecasts.

Once the methodology completed the computations for all intervals, it would check to determine whether the user provided inputs for more than one course of action. If so, then it would repeat all of the above computations for each of the remaining courses of action. Then, or if only one course of action were provided, the methodology would proceed to its output routines, where it would present the data required for comparing forecasts and other purposes.

Output

Recall, however, that the user should be able to control output, receiving only the information he actually needs. For this reason, the basic output from the methodology, and the only one provided as a default, would be the "worst case" overview. On one graph, the methodology would plot the worst case data for each of the major categories of personnel, equipment, fuel, and ammo. It would do this for each of the time intervals defined by the user, and for each course of action for which the user provided inputs. An example of this "worst case" overview is provided in Figure 3, which shows that all four major categories fall below the commander's critical value before the operation ends.

This single graph is one of the methodology's most important features. It would provide the capability to determine, virtually at a glance the anticipated consequences of one or more courses of action to each of the major components of a unit's fighting systems. At the same time, it would allow the commander and his staff to compare one course with another, and to determine quickly both where and when shortfalls could be expected to occur in each course. Further, it could aid staff officers to manage information by exception. If the graphic or tabular representation for a particular category of resources never dropped below a predetermined critical level, then the staff officer could ignore that category and focus attention on problem areas.

All other outputs would be displayed only on user demand. Thus, the user would have nearly total control of the information provided by the methodology. Because the methodology would save the results of computations in temporary storage and use a bottom-up approach in computations, information would be available for all echelons, from the lowest echelon for which data were maintained in the data base, up to the level for which the forecast was generated.

Having examined the "worst case" overview, the user could look at projected status in increasing detail. A corps-level user could look at any level of detail for corps-level data. For example, Figure 3 shows that fuel is the most immediate problem in both courses of action. The more detailed fuel breakdown in Figure 4 shows that all fuel types pose problems, but that a shortage will occur first in JP-4. Recall that Figures 3 and 4 take into account on-hand supplies as well as resupply and consumption. Figure 5 summarizes a comparison of anticipated requirements with anticipated resupply. The figure shows that now supplies of fuel will fall far short of requirements. Also, he could look at echelons below his own. For example, he could obtain a "worst case" overview for one or more of the corps' divisions, and then look at their data in whatever detail he desired. In each case, the information he received would be under his control. Other examples of more detailed information are provided in Appendix C.

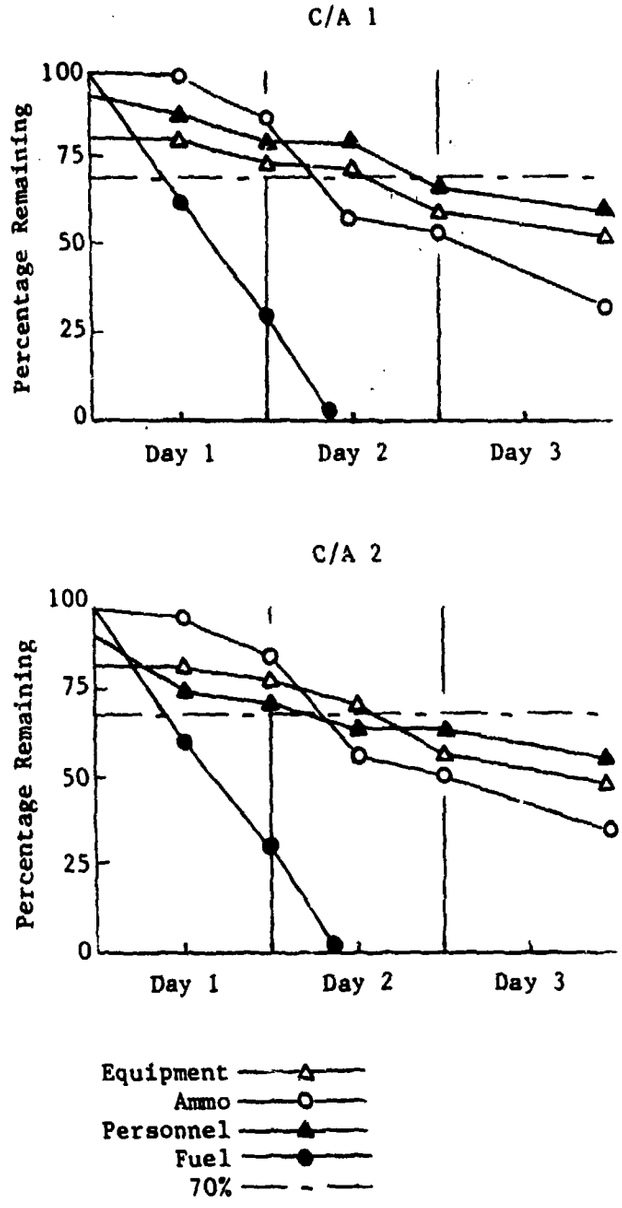

Figure 3. Percentage of Remaining Capability of Equipment, Fuel, Ammo, and Personnel for Courses of Action 1 and 2

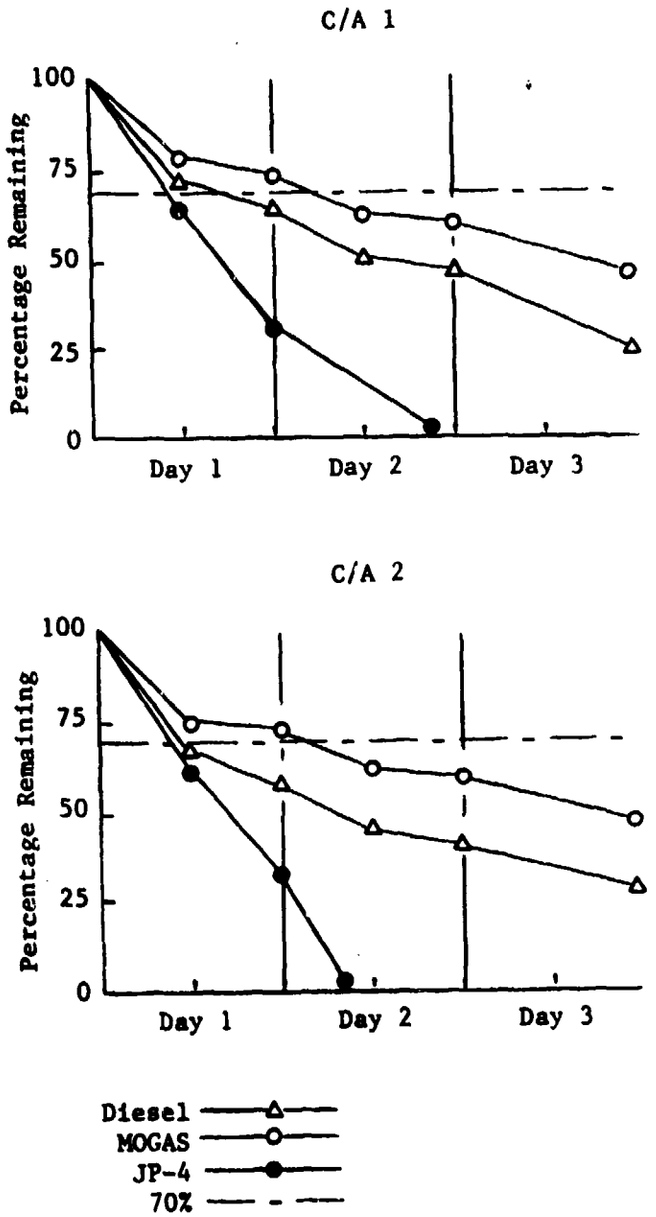

Figure 4. Percentage of Remaining Capibility of Diesel, MOGAS, and JP-4 for Courses of Action 1 and 2

FUEL ALLOCATION

C/A 1

	Forecasted Requirement	Percentage of Requirement Received
1st Day	191,638 gal. MOGAS	25%
	711,404 gal. JP-4	27%
	1,235,321 gal. Diesel	19%
2nd Day	118,341 gal. MOGAS	40%
	438,691 ga. JP-4	44%
	713,845 gal. Diesel	33%
3rd Day	134,300 gal. MOGAS	36%
	379,430 gal. JP-4	51%
	787,691 gal. Diesel	30%

C/A 2

	Forecasted Requirement	Pipeline Supply
1st Day	202,734 gal. MOGAS	23%
	709,646 gal. JP-4	27%
	1,396,987 gal. Diesel	17%
2nd Day	118,749 gal. MOGAS	40%
	458,828 gal. JP-4	42%
	739,594 gal. Diesel	32%
3rd Day	114,920 gal. MOGAS	42%
	376,594 gal. JP-4	51%
	631,458 gal. Diesel	38%

Figure 5. Fuel Allocation Compared to Fuel Requirements

Data Base Considerations

The Resource Planning Aid would require a relatively small portion of the total admin/log data base. Nonetheless, as shown in Table 2, the methodology's data requirements would not be trivial.

Note in Table 2 that all fuel burning machines would have to be listed in the Resource Planning Aid data base, if it were to provide maximum precision. Furthermore, a fuel type would have to be associated with each machine, and an ammo type with each weapon. These data would be essential for forecasting fuel and ammo consumption. For example, while generators ordinarily might not be a major consideration in planning tactical operations, they do burn fuel and therefore, their existence would have to be taken into account in computing a fuel forecast.

The same type of reasoning applies to personnel. The data base would have to contain information about the status of every combination of MOS/SSI and grade, if the methodology were to be maximally precise. Only in this way could forecasts of losses to individual MOS/SSI-grade combinations be computed and then summed to produce forecasts at less minute but often more useful levels of detail.

Furthermore, maximum utility of the methodology would depend upon maintaining the data in the hardware at a level one echelon below the lowest for which resource planning was to be supported. Thus, for example if forecasts were to be generated for battalions/task forces/squadrons, the data base would be maintained at the level of companies/company teams. Only in this way could forecasts be generated for all the assets in subordinate organizations and then rolled up in accordance with task organization to the organization of interest.

Many of the data items would be entered during system start-up; examples are loss rates, fuel types, and fuel consumption rates. Thereafter, they would be changed infrequently, as for example when new equipment entered the inventory, or when new loss rates become available. Normally, group definitions would be entered once, and then changed only when necessary to reflect a change in commander's guidance. However, they could be changed at any time, at the user's option. Three items, all concerned with fuel, are available only from manual reports and therefore would have to be updated manually. The remaining items would be available either from manual reports or from automated admin/log subsystems being developed by organizations such as ADMINCEN, LOGCEN, and CACDA.

Until these subsystems become available, a version of the methodology reduced in precision from that proposed here for the mid-1980s might use the data base currently maintained by the corps. This data base is updated regularly by

Table 2. Data Base Requirements and Data Sources

1. Selected Class VII Items. Consists of all fuel-burning machines, plus all non-self-propelled weapons of interest.	
a) line or stock number	to be entered once
b) authorized	SAILS, manual reports, TOE
c) on-hand	SAILS, manual reports
d) in maintenance	SAMS, manual reports
1) when due out	SAMS
e) lost	SAILS, manual reports
f) operationally ready	SAILS, manual reports
g) when replacements due in	SAILS
h) intensity factors	to be entered once; modified at user's option
i) type of fuel by machine	to be entered once
j) type of ammo by machine	to be entered once
k) loss rates (WARF)	to be entered once
l) firing rates, by type of operation	to be entered once; modified at user's option
m) fuel consumption rates	to be entered once
n) fuel usage rates	to be entered once; modified at user's option
o) group definitions	to be entered at user's option
2. Ammo	
a) locations of ASPs	Tactical Command & Control System, CSS control program
b) stockage levels	SAAS, manual reports
c) on-hand levels	SAAS, manual reports
d) when resupply due in	SAAS
e) group definitions	to be entered at user's option
3. Fuel	
a) locations of fuel supply points	manual reports
b) amounts on-hand	manual reports
c) when resupply due in	manual reports

Table 2. Continued

4. Personnel. All data items must be kept in terms of grade (by officers, warrant officers, and enlisted soldiers), of MOS, and of service branch.	
a) authorized	SIDPERS, manual reports
b) assigned	SIDPERS, manual reports
c) present for duty	SIDPERS, manual reports
d) loss factors	to be entered once
e) when replacements due in	SIDPERS
f) group definitions	to be entered at user's option
5. Task Organization	Tactical Command & Control System

manual reports from subordinate units. It contains no data on, for example, generators or construction equipment; however, such items could be taken into account by the use of constants derived from TOE and planning factor data. Thus, a fuel consumption rate for, say, trucks in general could be established by taking the average consumption rate for all the trucks in a unit's TOE. Then, fuel consumption for trucks could be forecast by multiplying the average rate times the estimated density times estimated distance to be traveled. Such a forecast obviously would lack the precision of the forecast obtained from the more sophisticated version of the methodology. Obviously, the reduced version would require validation in the user community to ensure that the level of precision obtained met or exceeded the user's requirements.

User Inputs

The user's inputs to the methodology depend on his purpose. SDC anticipates that the first interaction between the methodology and the user would be a menu selection for data retrieval (i.e., retrieve a specific datum from the data base), data synthesis (i.e., determine the status of, for example, an armored division's tanks), or forecast generation. Data for forecast comparisons would be generated automatically if the user specified more than one course of action, as would implicit comparisons of predicted losses and consumption with existing and anticipated resources. Comparisons of predicted status and experience would be selected from the menu.

Data retrieval and synthesis. The user would select these capabilities through a combination of menus and simple instructions or queries from the methodology. For example, if the user selected data retrieval from the menu, the methodology would next provide a menu allowing the user to select equipment, ammo, fuel, or personnel. If the user selected, say, personnel, the methodology would ask for a specific MOS/SSI-grade combination and then retrieve the desired datum.

If the user selected data synthesis, the next menu would allow selection of equipment, ammo, fuel, or personnel. The user could then specify the particular information he wanted assembled, and the methodology would roll up discrete data items for presentation.

Forecasting. Table 3 lists the inputs required for generating and comparing forecasts. Most of these inputs are specific to the unit, its mission, or to particular courses of action. They depend on a preliminary analysis of the mission and alternative courses of action (e.g., length of operation, lengths of time intervals, distances, combat intensities, task organization). In the future, unit status and task organization data would be extracted from automated subsystems currently in development, via an electronic interface. Until these subsystems become available, however, these data would have to be entered manually.

Table 3. Inputs to the Methodology for Forecasting Purposes

User Inputs

- Unit identification
- Mission (attack on a position, defense of a position, etc.)
- Course of action number (a number to distinguish among alternative courses of action)
- Length of operation in hours or days
- Lengths of time intervals into which operation length is to be divided
- Distance unit will travel during each time interval
- Percentage of distance in each time interval that will be traveled on roads
- Estimate of combat intensity during each time interval
- Type of output desired (graphic or tabular)

Machine Inputs

- Status of the unit
- Task organization

EVALUATION OF THE RESOURCE PLANNING AID CONCEPT

The methodology had both logical and intuitive appeal to all parties concerned at Fort Leavenworth. Nonetheless, they recognized that a proper evaluation of the concept could be conducted only in the user environment, to determine whether Personnel Administration, Logistics, and Operations personnel in the field regarded the methodology as a potentially useful tool in the reduction and analysis of tactically-related admin/log data. A structured demonstration of the methodology appeared to be the most feasible approach to this evaluation, given resource constraints and the availability of potential users. This approach first required descriptions of the methodology's data base, its inputs, its data processing procedures, and the outputs it would generate for different tactical conditons. After presenting the demonstration to potential users in a briefing format, their reactions to the concept would be obtained by means of a questionnaire. This approach is described in detail below.

METHOD

Participants

To evaluate the methodology, 84 male and 3 female USAREUR officers completed the questionnaire. They ranged in rank from 2LT to COL, and represented 35 duty positions. Their experience in these positions varied from one day to 48 months. The distribution of these officers by echelon and months of experience in duty position is shown in Table 4.

Table 4. Distribution of Evaluation Participants by Echelon and Experience in Duty Position

	Experience in Months					
Echelon	Less than 7	7-12	13-24	Over 24	No Response	Total
Theater	8	0	1	2	0	11
Corps	8	5	11	5	2	31
Division	6	5	4	0	4	19
Brigade	5	1	3	0	0	9
Battalion	10	4	2	0	1	17
Total	37	15	21	7	7	87

The sample actually obtained differed both in size and composition from that originally planned. That is, the evaluation team requested participation from the G1/S1, G3/S3, and G4/S4 sections of all theater, corps, division, and brigade headquarters, and from at least three battalions in each division. However, other commitments precluded participation by one entire division. The number of participants obtained from other units was smaller than projected for similar reasons. The sample composition differed from the original plan because the units could not always make available the requested mix of principal and action officers. For example, one division could provide only its principals' deputies, and brigades and battalions frequently could provide only junior officers. These deviations from the planned sample precluded some of the data analyses planned for the evaluation. Even so, the obtained sample appeared sufficiently representative of the USAREUR units that statistical and observational results presented later in the report are valid, and provide an adequate foundation for conclusions and recommendations discussed at the end of the report.

Materials

The demonstration script and participant questionnaire constituted the only materials prepared especially for the evaluation. These materials are described immediately below.

Demonstration script. The demonstration script explained the methodology and illustrated its capabilities in a three-part briefing, as follows.

1. Introduction. Introductory portion reviewed the mission of the ARI Fort Leavenworth Field Unit and the relationship of SDC's work under this contract to that mission. The introduction emphasized the current year's work summarizing the previous visit to USAREUR, explaining the purpose of the current visit, and highlighting the assumptions described earlier, under "Conceptual Description of a Resource Planning Aid,"

2. Tactical scenario. The second portion of the briefing consisted of a description of a tactical scenario that served as a vehicle for demonstrating the methodology. The scenario, extracted from Command and General Staff College (CGSC) tactics course materials, depicted an offensive operation conducted by a hypothetical Army Corps in a European environment. The script described events leading to the assignment of the mission, the admin/log status of the corps at the beginning of the operation, the terrain, avenues of approach, alternative courses of action, and the tactical advantages and disadvantages of each course of action. Throughout this portion, the script emphasized the relationships of these tactical issues to resource implications for conducting operations, and the Resource Planning Aid itself, particularly as they affected the user interface with the methodology.

3. Methodology, and sample outputs. This portion of the script provided description and illustration of the Resource Planning Aid concept and its capabilities. The script explained the methodology itself, the means by which it capitalized on current Army projects, the data base, and the output graphs and charts. Throughout this portion, the script emphasized application of the methodology as a job aid for the tactical decision process. However, the script also mentioned other applications, such as aiding admin/log efforts to implement and support the commander's decision. The entire demonstration script is reproduced in Appendix C.

Questionnaire. In coordination with the COTR, project personnel developed a questionnaire to elicit participant responses to the methodology. The questionnaire (see Appendix A) asked for the reactions of participants to five specific capabilities described below, their overall reactions to the methodology, and any comments they might have regarding deficiencies in the methodology as described, or any additional uses it might have, and on any other issues they cared to raise.

Procedure

Preliminary sessions. To test the evaluation materials and to inform interested Army personnel of its activities, the evaluation team conducted preliminary sessions at Fort Leavenworth for members of CACDA, the Combined Arms Training Developments Activity (CATRADA), and the CGSC. These sessions consisted of the full demonstration briefing plus the discussion period. The questionnaire was presented at two of these sessions. Although participants were not asked to fill them out, they were asked to comment on the questionnaire's contents as well as any aspect of the briefing. In addition, to ensure that the demonstration briefing did not conflict with or misrepresent their positions, the briefing was presented to interested officers at the ADMINCEN and LOGCEN. Participants assured the evaluation team that they saw no conflict or misrepresentation. Constructive criticisms from several sessions led to minor improvements in the demonstration script.

Evaluation sessions. The evaluation team conducted sessions at the headquarters of the European theater, two corps, two armored divisions, and one mechanized infantry division. Each session began with an Army officer, either the Point of Contact or the CACDA team member, introducing the team and briefly describing its mission. The COTR, CACDA, and SDC team members then delivered their respective portions of the demonstration briefing. They encouraged participants to interrupt with questions at any time, and the appropriate evaluation team member dealt with queries as they occurred.

At the end of the briefing, the team solicited any additional questions and any comments the participants might wist to offer. A team member handed out the questionnaires during this discussion period, and encouraged all participants to fill them out. The session ended when questionnaires were completed, all questions were answered, and no further comments were forthcoming.

Treatment of the Data

Evaluation sessions yielded data directly for nine variables, as described in Table 5. In addition, prior to data analysis, three other variables were created (those below the broken line in Table 5) by recoding one or another of the variables above the broken line.

Variable 10 (Participant's organization) resulted from coding the unit to which the participant belonged. The values of Variable 10 are: (1) Theater HQ; (2) Corps #1 HQ; (3) AD #1 HQ; (4) AD #1 Brigades and Battalions; (5) Corps #2 HQ; (6) AD #2 HQ; (7) AD #2 Brigades and Battalions; (8) ID #2 HQ; (9) ID #2 Brigades and Battalions. This variable provided information about responses from participants in specific organizations.

Table 5. Variables for Which Data Were Collected During Evaluation Sessions.

Variable	Description
1	Participant's duty position (e.g., battalion AG; assistant division G4 for funds; corps G1
2	Numbers of months assigned to duty position
3	Echelon of participant's organization (e.g., theater, corps, battalion)
	Participant's Response to Questionnaire Item:
4	1 (methodology as a source of information for evaluating the admin/log "costs" of a particular course of action)
5	2 (methodology as a tool for exploring contingencies within a particular course of action)
6	3 (methodology as a source of information for comparing the admin/log "costs" of a different course of action)
7	4 (methodology as a tool to help the G1/S1 and G4/S4 contribute to the commander's tactical decisions)
8	5 (methodology as an aid to participant's own planning activities in support of tactical operations)
9	6 (participant's overall judgement as to need for the methodology in the field)
10	Participant's organization (e.g., First AD, Corps #1, Theater HQ)
11	Participant's "staff section" (either G1/S1, G3/S3, or G4/S4)
12	Major Command of participant's organization (either Theater, Corps #1, or Corps #2)

The large number of duty positions occupied by the participants prompted the creation of Variable 11 (Participant's "staff section"). Recall that the 87 officers represented a total of 35 different positions; so large a number made meaningful analysis of Variable 1 (Participant's duty position)prohibitively difficult. Therefore, Variable 1 was recoded to create Variable 11, as follows. All G1/S1, G3/S3, and G4/S4 duty positions were defined by those labels (i.e., modifiers such as "for Plans" and "for Operations" were dropped). Ag officers were grouped with G1/S1 officers, since they perform functions analogous to those of G1/S1 officers. By a similar line of reasoning, support

command officers and officers assigned as, for example, brigade motor officers were grouped with G4/S4 officers, and executive officers were grouped with G3/S3 officers. Variable 11 therefore had three possible values: (1) G1/S1; (2) G3/S3; and (3) G4/S4.

Variable 12 (Major command of participant's organization) was created by recoding Variable 10 (Participant's organization), according to whether the participant was assigned to a unit in Theater HQ USAREUR, Corps #1, Corps #2. The purpose of this variable was to allow examination of responses by the three major commands in USAREUR.

Experimental design. As originally conceived, data were to be analyzed in two phases: (1) a correlation analysis; and (2) a two-way analysis of variance of echelons by duty positions. The correlation analysis would permit project personnel to evaluate the relationships among questionnaire items. The two-way analyses of variance would permit them to evaluate, not only the main effects of echelon and duty position, but also any interactions between these two variables. However, because the obtained sample differed from the one planned, the latter analysis had to be discarded. In its place, the one-way analysis of variance was used. The one-way analysis sacrificed information about interactions, but permitted analysis of main effects. The correlation analysis was carried out essentially as planned. All statistical analyses were performed with the Statistical Package for the Social Sciences[9].

RESULTS AND DISCUSSION

Overall Findings

Table 6 shows the frequencies of responses and percentages of total responses to the questionnaire items asking for participant's reactions to the methodology's various capabilities and for their overall reaction to the concept. The table shows that relatively few of the participants responded with "not useful" or gave no response to items concerned with specific capabilities. The remaining participants divided their responses about equally among the three more positive alternatives. Indeed, on the average about 84% of the participants rated each capability as at least "marginally useful," and 27% rated them as "very useful." Meanwhile, about 57% believed that the methodology is needed in the European environment, and 18% expressed this view strongly.

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9. Nie, N.H., Hull, C.H., Jenkins, J.G., Steinbrenner, K., and Bent, D.H. Statistical Package for the Social Sciences (2nd Ed.). New York: McGraw-Hill Book Company, 1975.

Table 6. Absolute Frequencies (f) of Responses and Percentages of Total Response (%) to Questionnaire Items on Resource Planning Aid Capabilities and Overall Reaction to the Methodology.

	Variable											
	4 C/A Analysis		5 Assess Contingencies		6 C/A Comparisons		7 Decision Aid		8 Staff Planning		Mean	
Response	f	%	f	%	f	%	f	%	f	%	f	%
3 = very useful	24	27.6	20	23.0	29	33.3	21	24.1	22	25.3	116	27.0
2 = moderately useful	25	28.7	26	29.9	21	24.1	24	27.6	23	26.4	119	27.0
1 = marginally useful	28	32.2	26	29.9	26	29.9	25	28.7	25	28.7	130	30.0
0 = not useful	5	5.7	6	6.9	5	5.7	7	8.0	11	12.6	34	8.0
no response	5	5.7	9	10.3	6	6.9	10	11.5	6	6.9	36	8.0
Total	87	100.0	87	100.0	87	100.0	87	100.0	87	100.0	435	100.0

Response to Variable 9 Overall Reaction	f	%
5 = strongly feel it's needed	16	18.0
4 = feel it's needed	34	39.0
3 = not sure it's needed	27	31.0
2 = feel it's not needed	6	7.0
1 = strongly feel it's not needed	4	5.0
Total	87	100.0

These results indicate support for implementing the methodology in the European theater. However, inspection of the raw data suggests that the degree of support varies with echelons and with organizations within echelons. Furthermore, these variations do not appear to be simple linear functions. These views are supported by the more detailed analyses reported below.

Correlation Analysis

Pearson Product-Moment Correlation Coefficients were computed for all possible pairs of variables 1 through 12. Table 7 lists these coefficients, with statistically significant ($p < .05$ or lower) values underlined.

Table 7. Correlation Coefficients and Significance Levels of All Possible Pairs of Variables 1 Through 12.

	Variable											
Variable	1	2	3	4	5	6	7	8	9	10	11	12
1		.09	.47	.20	.16	.17	.27	.19	.30	-.29	.09	-.02
2			.27	.13	.12	.08	.17	.09	.11	-.11	.06	.09
3				.20	.20	.18	.29	.29	.39	-.63	.17	.27
4					.79	.84	.66	.72	.67	-.02	.12	.03
5						.85	.72	.80	.69	.07	.11	.06
6							.75	.81	.64	.03	.14	.12
7								.84	.72	-.02	.26	.09
8									.72	-.02	.21	.10
9										-.20	.20	.01
10											-.04	-.06
11												-.09
12												

Note: Underlined values are statistically significant beyond at least the .05 level.

Note that, with one exception, the strongest correlations are between pairs of Variables 4 through 9, which are the six multiple-choice questionnaire items eliciting responses to specific features of the methodology and the participant's overall reactions to it. The one exception was moderate negative correlation between Variables 3 (Echelon of participant's duty position) and 10 (Participant's organization). Few of the correlations between pairs of Variables 1, 2, 3, 10, 11 and 12 are statistically significant, and none are large.

The strengths of the correlations between pairs of multiple-choice items, ranging from .64 to .85, suggests that participants responded relatively consistently to these items. That is, if a participant found one of the methodology's features useful, then he or she found the other features useful as well, and believed that the methodology as a whole is needed. On the other hand, if a participant found one feature not useful, then he or she found the other features not useful as well, and believed the methodology was not needed. Of course, correlation coefficients reveal nothing about the absolute magnitudes of participants' responses. However, analyses of these magnitudes are reported and discussed below.

The negative correlation between Variables 3 and 10 appears to be an artifact of the coding scheme for these variables. Echelons were coded from 1 to 5 to represent battalion through theater, respectively. By contrast, organizations were coded from 1 to 9 to represent the specific organizations to which participants were assigned (e.g., 1 = Theater HQ, 2 = Corps #1 Hq, 3 = AD #1 HQ, etc.). Thus, the fact that the two variables are correlated yields no important information.

The low correlations among Variables 1 - 3 and 10 - 12 (with the exception already noted) indicate that these variables are essentially independent of each other, and of Variables 4 through 9. This finding suggests that whatever the relationships between the independent variables (numbers 3, 10, 11, and 12) and the dependent variables of this evaluation (numbers 4 through 9), they will not be linear functions. This interpretation is confirmed by the following results.

One-Way Analyses of Variance

One-way analyses of variance were performed on four independent variables: major command, echelon, organization, and "staff section." On each of these variables, data were analyzed for participant's responses to each of the six multiple-choice items (Variables 4 through 9), a total of 24 analyses in all. F-ratios from these analyses are presented in Table 8.

Table 8. F-ratios from One-Way Analyses of Variance of Questionnaire Items 1 Through 6 (Variables 4 Through 9) by Major Command, Echelon, Organization, and "Staff Section."

	Variable					
Independent Variable	4 C/A Analysis	5 Assess Contingencies	6 C/A Comparisons	7 Decision Aid	8 Staff Planning	9 Overall Reaction
Major Command	4.35	6.06	4.89	8.60	9.15	11.35
Echelon	3.34	2.22	2.53	3.88	4.30	7.27
Organization	3.40	3.56	2.72	4.12	4.04	4.86
"Staff Section"	0.83	0.55	0.71	2.60	1.92	3.16

Note: Underlined values are statistically significant beyond at least the .05 level.

Tukey's "Honestly Significant Differences" test[10] was used to compare group means for each analysis that was statistically significant. The test computes all possible comparisons for the groups within any independent variable; however, in presenting the following results, only comparisons that yielded at least one statistically significant difference are shown.

Major commands. Table 9 summarizes the Tukey comparisons for major commands. The table shows that, for four of the six questionnaire items, theater headquarters personnel differed in their responses from one of the corps surveyed. By contrast, theater differed significantly from the other corps only in overall reactions to the methodology (Variable 9). The striking feature of the table, however, is that the two corps differed significantly on all six measures. Table 10 amplifies these findings, showing that mean responses from Corps #2 participants were essentially indistinguishable from those of theater, and that both were higher than those of Corps #1.

The data do not reveal why one corps should differ markedly from the other two major commands in USAREUR. One might surmise that, if major commands differed significantly at all, then the difference would occur in responses of the two corps compared with theater. Table 10 shows that this is not the case. That the explanation for these findings does not lie merely in differences among echelons is further illustrated by the analysis of data for this variable.

Echelons. Table 11 shows the results of comparisons among echelons.

Two features of the table are worthy of note. First, there is a total absence of significant comparisons among echelons for Variables 4, 5, and 6. Second, of the 11 significant comparisons, only three involve adjacent echelons (i.e., those separated by one level of command). The first finding indicates that echelons generally agreed in their perceptions of the methodology's capabilities used to explore the admin/log implications of projected courses of action, as elicited by items 1, 2, and 3 on the questionnaire. However, they differed in their perceptions of those capabilities used to help the G1/S1 and G4/S4 contribute to the commander's tactical decisions, to facilitate their own tactically-related planning activities, and in their overall reaction to the methodology.

In this regard, one might have expected mean responses to vary systematically with echelon, with higher values at higher echelons and progressively lower values at lower echelons. This hypothesis seems plausible in light of the fact that, at higher ecelons, operations are planned farther in advance,

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10. Winer, B.J. Statistical Principles in Experimental Design. New York: McGraw-Hill Book Company, 1962.

Table 9. Comparisons Among Groups Within the Main Effect of Major Commands.

	Variable					
Comparison	4 C/A Analysis	5 Assess Contingencies	6 C/A Comparisons	7 Decision Aid	8 Staff Planning	9 Overall Reaction
Theater with Corps #1	X			X	X	X
Theater with Corps #2						X
Corps #1 with Corps #2	X	X	X	X	X	X

"X" indicates a statistically significant ($p < .05$) comparison

Table 10. Mean Responses to Questionnaire Items 1 Through 6 (Variables 4 Through 9) by Major Command.

Major Command	Variable 4 C/A Analysis $\bar{x}$	4 C/A Analysis s	5 Assess Contingencies $\bar{x}$	5 Assess Contingencies s	6 C/A Comparisons $\bar{x}$	6 C/A Comparisons s	7 Decision Aid $\bar{x}$	7 Decision Aid s	8 Staff Planning $\bar{x}$	8 Staff Planning s	9 Overall Reaction $\bar{x}$	9 Overall Reaction s
Theater	2.3	.90	2.0	.89	2.2	.98	2.4	.97	2.3	.90	4.6	.50
Corps #1	1.5	.96	1.2	.94	1.5	.96	1.3	1.01	1.1	1.04	3.3	1.10
Corps #2	2.1	.82	2.1	.77	2.3	.80	2.2	.77	2.1	.85	3.9	.73

Table 11. Comparisons Among Groups Within the Main Effect of Echelons.

	Variable					
Comparison	4 C/A Analysis	5 Assess Contin-gencies	6 C/A Compar-isons	7 Decision Aid	8 Staff Planning	9 Overall Reaction
Theater with Corps						X
Theater with Brigade					X	X
Theater with Battalion				X	X	X
Division with Brigade					X	X
Division with Battalion				X	X	X

"X" indicates a statistically significant ($p<.05$) comparison

providing more time for tactical planning. Also, commanders and their staffs at higher echelons encounter fewer constraints, such as terrain and resources, in their planning. However, the data do not support this hypothesis, as shown in Table 12, which illustrates clearly the lack of linear relationship between independent and dependent variables noted earlier, under "Correlation Analysis."

Notice in the table that for three of the six dependent measures, division means are higher than theater means, although the differences are not great, and certainly not statistically significant. Also, differences are not significant between corps and division, and yet in all cases, the division means are larger. A similar pattern appears at the bottom of the table, where battalion means are higher than brigade means five times out of six, although the differences once more are neither large nor statistically significant. Even so, these results clearly do not support the hypothesis that a higher echelon would always perceive greater utility in the methodology than would a lower echelon.

One might view the results in a somewhat different way. If the means for theater, corps, and division were averaged together, then the average for each of the six variables would be higher than the corresponding value for brigades and battalions averaged together. That is, units with a "G" staff average more positive responses to the methodology than do units with an "S" staff. This is a plausible hypothesis, but it becomes difficult to defend when one examines the data broken down by organization. For, these data show inconsistencies even among units at the same echelon.

Participant's organization. Of 216 possible comparisons among the nine organizations on the six dependent measures, only six reached statistical significance. That number of significant results could have occurred purely by chance ($p<.03$). Therefore, those comparisons are not presented here. Nonetheless, the data for organizations are illuminating, as shown in Table 13, with units below theater numbered to indicate subordination.

Even after data for divisions, brigades, and battalions are separated out, the two corps differ in their reactions to the methodology's various capabilities. The same finding occurs at the level of division. The two armored divisions (one from each corps) agreed with each other, on the average, but the infantry division disagreed with both. That pattern appears again in the respective divisions, brigades, and battalions. Granted, these comparisons do not reach statistical significance; still the data show a non-linear trend that is remarkably consistent across the six dependent measures.

The data do not indicate why the reactions of one corps staff should differ from those of another, or why those of two divisions should differ from those of a third. Possibly the explanation lies in differences in command philosophy, or the styles of different staffs. Perhaps the results were

Table 12. Mean Responses ($\bar{x}$) and Standard Deviation(s) for Questionnaire Items 1 Through 6 (Variables 4 Through 9), Broken Down by Echelon.

	Variable											
	4 C/A Analysis		5 Assess Contingencies		6 C/A Comparisons		7 Decision Aid		8 Staff Planning		9 Overall Reaction	
Echelon	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Theater	2.4	.90	2.0	.89	2.2	.98	2.4	.97	2.3	.90	4.7	.50
Corps	1.7	.87	1.8	.83	1.9	.91	1.7	.94	1.7	.97	3.7	.83
Division	2.4	.74	2.3	.73	2.5	.74	2.3	.72	2.4	.74	4.1	.77
Brigade	1.3	.95	1.3	.82	1.3	.82	1.3	.82	0.9	.69	2.9	.64
Battalion	1.5	.92	1.4	1.12	1.5	1.06	1.2	.89	1.2	1.13	3.0	1.14

Table 13. Mean Responses to Questionnaire Items 1 Through 6 (Variables 4 Through 9) by Participant's Organization.

	Variable											
	4 C/A Analysis		5 Assess Contingencies		6 C/A Comparisons		7 Decision Aid		8 Staff Planning		9 Overall Reaction	
Org.	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s	$\bar{x}$	s
Theater HQ	2.3	.90	2.0	.89	2.2	.98	2.4	.97	2.3	.90	4.6	.50
Corps #1 HQ	1.3	.87	1.2	.71	1.3	.87	1.1	.78	1.1	.78	3.2	.97
ARM DIV #1 HQ	2.7	.58	2.3	.58	2.7	.58	2.3	1.15	2.3	1.15	4.7	.58
ARM DIV #1 BDE & BN	1.2	.92	0.9	.99	1.2	.92	1.1	1.05	0.8	1.03	2.8	1.03
Corps #2 HQ	1.9	.83	2.1	.77	2.2	.81	2.1	.85	2.0	.94	3.8	.73
ARM DIV #2 HQ	2.8	.46	2.6	.52	2.8	.46	2.6	.52	2.6	.52	4.2	.67
ARM DIV #2 BDE & BN	1.0	.00	1.5	.71	1.5	.71	0.7	.58	0.7	.58	2.7	1.53
INF DIV #2 HQ	1.5	.58	1.3	.58	1.8	.96	1.8	.50	1.7	.58	3.2	.50
INF DIV #2 BDE & BN	1.8	.92	1.9	.93	1.8	1.09	1.6	.52	1.6	1.01	3.3	.82

influenced by differences in mission, or of terrain. Or perhaps a combination of these factors explains the results. One other possibility is discussed later, under "Verbal and written comments."

The most important feature of Table 13 is the data for Variable 9, representing the participants' overall reactions to the methodology. Recall from the discussion of general findings that 57% of all participants indicated their belief that admin/log officers in the field need the Resource Planning Aid. The table shows that this view was held most strongly by participants at theater and the two armored divisions, and somewhat less strongly at one corps headquarters. Participants in other units, on the average, indicated some degree of uncertainty regarding the need for the methodology, but none of their mean values indicated a belief that it is not needed. These results suggest a perception on the part of USAREUR staff officers that while the methodology may not solve all of their tactically-related admin/log problems, it could become useful in their efforts to reduce and analyze tactically-related data, and to support tactical decision making and planning.

"Staff sections." That this view, however weakly or strongly held, is shared by G1/S1, G3/S3, and G4/S4 personnel is evident from the results of the analyses of variance for data on staff sections. These analyses yielded statistically significant differences among sections only for variable 9, and even that F-ratio barely reached the critical value ($F = 3.16$, $p = .0479$). Furthermore, the Tukey test revealed no statistically significant comparisons among the sections. Thus, G1/S1, G3/S3, and G4/S4 personnel evidently shared much the same views of the Resource Planning Aid. This finding reinforces the point made earlier that operations personnel are becoming increasingly aware of the importance of combat service support to tactical operations.

Verbal and Written Comments

The questionnaire invited three distinct types of comments from participants, those related to additional capabilities desired in the methodology, those concerning uses of the methodology other than uses described in the demonstration briefing, and general comments. Remarks voiced during discussion periods of data collection sessions also fell into one of these categories. Some of these comments were ambiguous, such as "Modularize factors for easy mix 'n' match use," and "Staffing for wartime requirements based on existing workloads." More than one interpretation could be offered for such comments; SDC elected to focus instead on those that could be interpreted unambiguously.

Additional capabilities desired. One suggestion was to include an enemy data base comparable to the friendly data base to aid in caclulating force ratios. Related to this comment was the remark that if available enemy status and

attrition data were included, future force ratios might be predicted as well. These suggestions appear to be worth investigating, particularly the latter one, because force ratios clearly affect the tactical planning process. Such assessments would depend on the capability to obtain intelligence data on enemy status in sufficient detail to permit the computations performed by the methodology. Additionally, planning factors would be required for enemy personnel, equipment, ammo, and fuel. Nevertheless, these suggestions should not be ruled out without further study.

One officer suggested that the methodology must be able to handle interactions. To paraphrase his explanation, as a unit loses weapon systems, their probability of loss increases. For example, as artillery tubes are lost, the firing rate of surviving tubes will increase, because the unit will attempt to fire its entire daily allotment. Since self-propelled tubes must stop to fire, however, the increased firing rate will cause a decrease in mobility. And because decreased mobility increase exposure to counter battery fire, the result will be an increased probability of loss. This officer's counterpart in the other corps did not share his view. Evidently, the other corps believed that preserving mobility took precedence over sustaining the total fire rate of friendly fire. This officer stated that individual weapon systems would retain their assigned firing rates, so that as losses occurred total expenditure of ammunition would decrease per unit of time. This disagreement is reminiscent of differences in reporting procedures and commanders' guidance. It underscores the need for flexibility in the methodology to accomodate differences between units.

Other uses. One participant suggested that the methodology could provide casualty forecasts for assessing medical resource requirements. Both verbal and written comments asserted that the methodology could be useful in training programs. One participant believed that the methodology's rigor and comprehensiveness could help to improve the credibility of logistics estimates among tacticians. Another suggested that its outputs could help to establish priorities for supplies. Still another suggested that status information and forecasts related to transportation equipment could aid in comparisons of the capabilities of various CSS units to receive and move cargo. Finally, a participant believed that the methodology could assist in the preparation of reports.

General comments. General comments focussed primarily on three issues: (1) the lack of field communications capabilities adequate to support computer applications planned for the mid-1980s; (2) the need for more realistic planning factors than those currently available; and (3) user burden imposed by the methodology. The demonstration briefing addressed all three of these issues. Participants were informed of efforts currently underway by the Army to improve communications and planning factors, and user input requirements were described explicitly.

Nonetheless, the issue of communications arose in every evaluation session, as did that of planning factors. In general, participants seemed unimpressed by assurances that Army agencies are working to alleviate these problems, frequently expressing their belief that solutions are not yet in sight. Evaluation team members generally agreed that these reactions generally were voiced more intensely in units of Corps #1 (and especially Corps HQ) than in Corps #2. Concern for user burden was neither as pervasive nor as intense in any of the sessions. Nonetheless, participants reflected their concern in remarks such as "We don't have time to operate systems like this one," and "If you send us this system, send an E- to operate it."

From observations during discussion periods, all three evaluation team members became convinced that concerns about communications, planning factors, and user burden affected the results reported earlier. Even some participants suggested this effect; witness the comment from a battalion officer quoted below. The briefing and questionnaire approach to the evaluation did not permit a quantitative assessment of this effect. Surely, though, the impact would be to reduce the degree of favorable response to the methodology.

Indeed, the effect of user concern about these issues may explain, at least in part, the differences in responses from units at the same echelons. One might conclude that, in those sessions in which concerns were expressed most intensely, reactions to the methodology were most negative. This is not to say that participant's responses were determined entirely or even primarily by their feelings about these issues. The effects of other factors suggested earlier remain viable possibilities. Nonetheless, a method for measuring the impact of all these factors, particularly those described immediately above, might have clarified other results considerably.

In addition to their concerns with these issues, brigade and battalion level participants stated that they spend too much time reacting to events, or responding to higher headquarters, to do much forecasting or planning. They also argued that they have too little leeway in tactical matters to derive much benefit from the methodology. However, two comments contradicted these general views:

> (a) We currently do too much reacting and not enough forecasting in combat situations. In this regard, the methodology could be very useful, even down to squadron/battalion level. Unfortunately, our evaluation may be colored somewhat, by a preoccupation with the communications, computer types, processing times, etc. due to having our fingers burned too often by overly complex and delicate systems/hardware in an era of extremely fast moving combat and progressively less capable soldiers. At tactical levels (division and below) you have a somewhat more emotional audience

concerned with implementations. Convince us that the hardware/software will be simple/fast/interference-free and you will probably find more support for the concept.

(b) Sounds like a fine system for advance planning. We spend a lot of time with pencils and "what if" meetings. This methodology should save a lot of time provided we can input the data faster than the time required to conduct the meeting and do the pencil work.

Finally, during one discussion on planning factors, a participant stated an intriguing proposal: "You have wargames at Leavenworth. Why don't you use them?"[11]

CONCLUSIONS

While views differed among echelons, and even among units at the same echelon, the major conclusion drawn from the evaluation data is that the enhanced capabilities provided by the Resource Planning Aid are needed by tactical units in the field, at least at levels of division and above. The methodology would provide assistance to staff personnel in the reduction and analysis of tactically-related admin/log data, and in their efforts to support tactical decision making and planning.

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11. DIVWAG, a division level, computer-supported wargame, provides resolution down to the level of individual weapon systems. Additionally, its computations probably take into account more of the variables that are important in combat (e.g., weather, terrain, hit/kill probabilities, dust) than does any other wargame. Currently, DIVWAG is used for highly specialized combat development activities. However, the wargame quite possibly could be used to generate the new planning factors that the participants said are needed so urgently.

    To obtain those factors would require that each of the variables in the wargame be varied through its full range of possible values while holding all the other variables constant. Clearly, an assessment would be required of the feasibility, requirements, and costs of such an approach. For example, it might require a dedicated computer. Still, it is worth the Army's consideration, for several reasons. First, the procedure would help to satisfy a need perceived by a large majority of the participants in the evaluation. Second, it would provide an independent check on results from the ADMINCEN and LOGCEN projects (and vice-versa). Finally, it might provide personnel and equipment factors that are correlated with each other in a systems context, so that predicted tank losses, for example, are consistent with predicted tank crew losses.

A subordinate conclusion is that the methodology would have application and utility in other areas of tactical activity. The area cited most often during evaluation sessions was training.

Participants were concerned that field communications could not support the methodology, that planning factors are inadequate to compute valid forecasts, and that the methodology might impose undue burden on the user.

Individual participants generally were consistent in their responses to the methodology's various capabilities, and these responses generally were consistent with their overall reaction to the methodology.

Finally, the methodology's utility could be further increased by adding capabilities suggested by participants in their verbal and written comments.

RECOMMENDATIONS

SDC recommends that definitive plans for development of the Resource Planning Aid be formulated and implemented. Further development of the methodology should take an evolutionary approach, beginning with a version more modest than that proposed for the mid-1980s. By initially reducing the scope of its data base along the lines described elsewhere in this report, it could be implemented relatively inexpensively. Moreover, this approach would provide assistance relatively quickly to field personnel whose current manual data processing and analysis methods are inadequate for resource planning tasks. A limited version could be developed that uses current data bases and data collection methods, and that does not depend on anticipated but presently unavailable communications capabilities.

Equally important, a limited version of the methodology would permit experience in the field to guide developers in the evolutionary process leading to more sophisticated and powerful versions. A working--albeit reduced--version could be tested in command post and field exercises. Data could be collected on numbers and types of user interactions with the methodology. Data could also be obtained on processing times and lengths of user sessions. Learning effects could be studied; error rates and types could be determined. User burden and other features of the methodology affecting user acceptance could be identified. Analysis of these data would provide information to improve the methodology, eventually leading to the version envisioned for the mid-1980s.

During development of the initial version, serious consideration should be given to suggestions from potential users reported earlier in this document. Two of these suggestions in particular merit attention. One is to include a capability to store and process enemy status data, and to generate enemy forecasts for comparison with those generated for friendly forces. This capability could add substantially to the methodology's utility and power. The other is that serious consideration be given to the feasibility of using the DIVWAG wargame in a systematic program to generate admin/log planning factors. That program could help to provide the valid, user-accepted planning factors upon which the effectiveness of the methodology depends.

SDC further recommends that any further work to develop the Resource Planning Aid continue to be guided closely by appropriate human factors principles. For example, close attention should be given to making user input instructions as simple and understandable as possible. This approach would ensure greater useability and productivity in the final product, and would do much to ensure user acceptance.

Finally, even the most sophisticated version of the Resource Planning Aid will not meet all of the tactically-related needs of the Personnel Administration and Logistics Elements. Battlefield dispatch of complete weapon systems is one of those needs. Others are discussed in Appendix B. Research should continue into these tactically-related functions, and data processing applications should be developed to support them.

Bibliography

1. Armored and Mechanized Division Operations. FM 71-100, Headquarters Department of the Army, 29 September 1978.

2. Combat Service Support. FM 100-10, Headquarters Department of the Army, April 1976.

3. Command and Control of Combat Operations. RB 101-5, U.S. Army Command and General Staff College, 15 August 1978.

4. Corps Automation Requirements Study, Volumes I and II, Final Report. BDM Services Company, 29 December 1977.

5. Corps Information Flow. Combined Arms Combat Developments Activity, 21 September 1978.

6. Corps Support Command. FM 54-9, Headquarters Department of the Army, 7 April 1978.

7. Draft Concepts on Control and Coordination of Corps Operations. RB 100-15, U.S. Army Command and General Staff College, 30 September 1977.

8. DIVWAG Model Documentation, Volume II, Programmer/Analyst Manual. TR 8-76, U.S. Army Combined Arms Combat Developments Activity, July 1976.

9. Functional Description for the USAREUR Command and Control Information System, Volume I, Overview. TRW Defense Space Systems Group, 15 February 1977, SECRET.

10. Larger Unit Operations. FM 100-15 (test), Headquarters Department of the Army, March 1974.

11. Material Management Center Corps Support Command. FM 54-23 (test), U.S. Army Logistics Center, 3 May 1976.

12. Modisette, B.R., Michel, R.R., and Stevens, G.W., Initial Strategies for the Tactical Operations (TOS) Support of Command and Control Process Volume 2. TM-6009/001/00, System Development Corporation, 7 February 1978.

13. Operations. FM 100-5, Headquarters Department of the Army, 1 July 1976.

14. Parrish, R.N. and Stevens, G.W., Development of Data Processing Strategies for Potential Application in the Tactical Operations System (TOS) and Other Automated Data Systems. TM-6257/000/00, System Development Corporation, 7 February 1979.

15. PEGASUS Combat Results Tables. GTA 71-2-1, U.S. Army Combined Arms Training Developments Activity, undated.

16. PEGASUS Rules. GTA 71-2-1, U.S. Army Combined Arms Training Developments Activity, undated.

17. Supply Control Combat Consumption Rates for Ground and Petroleum Products. SB 710-2, Headquarters Department of the Army, May 1978.

18. Staff Officers Field Manual Organizational, Technical, and Logistic Data. FM 101-10-1, Headquarters Department of the Army, 1 July 1976.

19. Staff Officers Field Manual Staff Organization and Procedure. FM 101-5, Headquarters Department of the Army, 19 July 1972.

20. Theater Army Logistics. FM 54-7, Headquarters Department of the Army, 30 November 1976.

21. Toward a Dynamic Relative Combat Power Estimator for Tacticians. (Master's Thesis), H.W. Nieuwbuer MAJ, Command and General Staff College, 1976.

APPENDIX A

Data Collection Forms

1. In-Depth Analysis
2. Evaluation of Computer Methodology

Data Collection Form for
In-Depth Analysis

TASK ANALYSIS

TASK NAME _____

Function name _____

Performer of the task _____

Inputs:

Data Items	Data Sources	Frequency of reception

Difficulties encountered in getting the required data items _____

Useful limits of the data in terms of age, reliability, and level of detail

TASK ANALYSIS (Continued)

Data Processing:

a) specific data processing steps, to include job aids:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

b) difficulties encountered in data processing operations (complexity, time time required to perform, etc)

_____

_____

_____

_____

_____

Outputs:

a) end product of the task_____

b) duty position to which delivered_____

Data Collection Forms for
Evaluation of Computer Methodology

RESOURCE PLANNING AID DEMONSTRATION

Participant Questionnaire

Please write your present duty assignment in the space below.

Please write the number of months you have been in your present duty assignment in the space below.

Please check the space beside the echelon of your current duty assignment.

____ a. Theater
____ b. Corps
____ c. Division
____ d. Brigade
____ e. Battalion

1. As a source of information for evaluating the admin/log "costs" of a particular course of action, I believe the methodology will be

____ a. very useful in the performance of my duties
____ b. moderately useful in the performance of my duties
____ c. marginally useful in the performance of my duties
____ d. not useful at all in the performance of my duties
____ e. not applicable to my duty position

2. As a tool for exploring contingencies within a particular course of action, I believe the methodology will be

____ a. very useful in the performance of my duties
____ b. moderately useful in the performance of my duties
____ c. marginally useful in the performance of my duties
____ d. not useful at all in the performance of my duties
____ e. not applicable to my duty position

3. As a source of information for comparing the admin/log "costs" of different courses of action, I believe the methodology will be

____ a. very useful in the performance of my duties
____ b. moderately useful in the performance of my duties
____ c. marginally useful in the performance of my duties
____ d. not useful in the performance of my duties
____ e. not applicable to my duty position

4. As a tool to help the one and four contribute to the commander's tactical decisions, I believe the methodology will be

____ a. very useful in the performance of my duties
____ b. moderately useful in the performance of my duties
____ c. marginally useful in the performance of my duties
____ d. not useful in the performance of my duties
____ e. not applicable to my duty position

5. As an aid to my own planning activities in support of tactical operations, I believe the methodology will be

____ a. very useful in the performance of my duties
____ b. moderately useful in the performance of my duties
____ c. marginally useful in the performance of my duties
____ d. not useful in the performance of my duties
____ e. not applicable to my duty position

6. Considering my overall reaction to the methodology, I

____ a. strongly feel that it's needed
____ b. feel that it's needed
____ c. am not sure that it's needed
____ d. feel that it's not needed
____ e. feel strongly that it's not needed

7. To make the methodology more useful in performing my tactically-related activities, I would recommend that the following capabilities be added:

8. In addition to helping the one and four contribute to the commander's tactical decision making, I believe the methodology would be useful to me in performing the following tasks or functions:

This page of the questionnaire has been left intentionally blank. Please feel free to use the space below for any comments, criticisms, suggestions or other reactions that you have to the methodology. Thank you for your attention, and for your cooperation.

APPENDIX B

General Processing Requirements and Desired Capabilities

In the course of interviews with action officers during the first visit to USAREUR, information emerged about a number of requirements and desired capabilities. Some of these requirements and capabilities relate directly to one or more of the potential applications that provided the focus for interviews. Others are not directly related to these applications, but are included here for completeness. The relationship of these requirements and capabilities to potential TC^2S applications and to corps staff elements are shown in Table B-1.

1. General Processing Requirements and Capabilities

(a) A requirement exists for the Corps G4 to have direct access to the division G4 data base.

Purpose: To perform overall planning at the corps level, logistics personnel must be able to review the availability of divisional assets as well as corps non-divisional assets.

(b) A requirement exists for more rapid and accurate processing of administration and logistics status data.

Purpose: To permit G1 and G4 to be more responsive to the needs of the Commanding General, and to devote a greater proportion of their time to analyzing the data base than to developing it.

(c) A requirement exists to generate and transmit automatically the Daily Battle Loss Report. This capability may also be desirable for the LOGSITREP. Included in this capability would be the reception and consolidation of division reports for corps.

Purpose: To consolidate key reporting requirements automatically for staff consumption. This requirement is representative of the general desire to free the staff from manual data base development and thus obtain more time for analysis of the data.

(d) A requirement exists to maintain the location of static facilities that could be used to store supplies, locate maintenance units and fuel storage areas, and to be able to maintain an audit trail of significant logistics locations. Current facilities in use also need to be maintained and monitored.

Purpose: The capability to store advanced planning data would enhance the G4 staff's ability to respond to the needs of the maneuvering forces and to support contingency planning.

(e) A requirement exists for the G4 personnel at main and corps rear to display the tactical disposition of corps assets.

Table B-1. The relationship of data processing reporting requirements to potential TOS CASE applications and to corps staff elements.

	Requirement or Desired Capability																								
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y
Resource Planning	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Force Composition Planning	x			x		x		x				x			x	x					x			x	
Battlefield Dispatch Assistance	x	x	x		x	x	x	x		x	x	x			x	x	x								x
Attrition Prediction						x									x	x									
Staff Section Concerned	G4	G1 G4	G4	G4	G4	G1 G4	G1 G4	G1 G3 G4	G4	G4	G4	G1 G3 G4	G1	G4	G1 G3 G4	G1 G3 G4	G4	G1 G4	G4	G1 G4	G3 G4	SURGEON	G1	G3	G4

Purpose: To improve corps main and rear staff interaction and planning through the use of graphics.

(f) A requirement exists for G1 and G4 staff personnel to hardcopy the situation or graphic displays they develop.

Purpose: To provide a permanent record of data and to aid staff interaction and planning.

(g) A requirement exists to develop and maintain an upgraded data base containing air, rail, water, and road networks. Additionally, a road network analysis and re-routing capability is essential.

Purpose: To plan and conduct the efficient movement of assets.

(h) A requirement exists for the G4 to track assets entering the corps as well as to track assets as they move forward in the corps. A similar requirement exists for the G1 to track personnel replacements and availability. This capability should include augmentation forces (TPFDL) in terms of unit shortfalls, maintenance needs, basic loads, parts load lists (PLL), and reconstitution requirements. This capability assumes that higher headquarters can provide corps with detailed information about incoming augmentation forces and/or replacements.

Purpose: To facilitate interstaff coordination, substantially improve G1-G4 planning, and satisfy G4 fill priorities.

(i) A requirement exists to maintain the status of transportation assets in order to move assets efficiently and effectively.

Purpose: To plan and control movement support more effectively within the corps.

(j) A requirement exists to maintain the status of Classes I, III, V, VII, and IX as directed by higher headquarters.

Purpose: To fulfill up-channel reporting responsibilities and to maintain the visibility of items such as spare parts (corps expects to depend heavily on the repair capability).

(k) A requirement exists to provide the G4 staff with data on major battlefield weapon system losses. Additionally, access to the battlefield is also essential to accomplish maintenance objectives.

Purpose: To ensure that weapon system losses are accurately reported and that replacement through requisition and timely maintenance is accomplished.

(l) A requirement exists for the G3 (through the G4) to pass priorities, weapon types, and numbers to the Support Command for implementation. Additionally, there is a requirement for the G3 to share with the G1 and G4 operational status data, task organization changes, status of units in need, front line traces, replacement and maintenance data, and other relevant tactical information.

Purpose: To satisfy the basic G1 and G4 need for tactical information, making them more aware and responsive to the needs of the maneuvering forces.

(m) A requirement exists to provide corps with unit strengths every four hours by percent of assigned crewmen. Battalion and brigade breakdowns should be by: combat, combat support, and combat service support categories. More explicit data are required every 12 hours by officer, warrant officer, enlisted soldiers, and by skills broken out by combat, combat support, and combat service support. Killed-in-action, wounded-in-action, and missing-in-action are also required. There are times when the G1 needs the casualty data to brief the Commanding General. Automatic roll-up of corps totals would be desirable.

Purpose: To satisfy the information needs of the commander and assist in assessing the combat capability of tactical forces. In at least one corps, the Commanding General used the number of casualties to assess operational effectiveness.

(n) A requirement exists to be able to load all DA, USAREUR, NATO and corps specific conversion rates so the machine can automatically calculate days of supply (DOS) for the classes being tracked.

Purpose: To relieve the staff officer of tedious and error-prone calculations which the machine can do faster and more accurately. The staff officer should be able to specify the data base item to be processed and the rate to be used.

(o) A requirement exists to convert basic system data to a form more usable in briefing the Commanding General.

Purpose: To transpose detailed data base information automatically into a form more usable by the staff in briefing the Commanding General. This capability would eliminate lengthy calculations by the staff, while still providing the basic summary of data the CG needs. The detailed data base, of course, would still be available for inspection by the CG if necessary.

(p) A requirement exists to plug in losses and gains and to produce trend forecasts for critical personnel skill categories, weapons, and/or supplies. Loss projection factors, not now available, would appear essential to any attrition function considered as part of this requirement. The forecasting capability should examine at least 24 to 48 hours into the future and describe critical shortfalls. Other considerations for forecasting are:

- Attrition outputs should be based on target arrays, weapon kills, and probabilities. Equipment considered should include tanks, self-propelled artillery pieces, M113, M577, recovery vehicles, and any system specified by the Commanding General. The purpose is to predict relative combat power in the future.

- Projections should not only forecast losses but also in which units they can be expected to occur, and when.

- Trend forecasting is required for fuel and ammunition by DOS and for equipment by operational ready (OR) and on-hand (OH).

- Historical data should be maintained for 6-7 days under current procedures.

- Trends should be maintained to verify expenditure rates.

Purpose: To provide the staff with a tool to project or anticipate critical shortfalls which might impact current or future operations. This capability, when coupled with item o above, provides the staff with a basic capability to tell the CG where the corps is now and where the potential pitfalls might be in terms of consumables and equipment.

(q) A requirement exists to locate and determine the status of heavy CSS equipment.

Purpose: To assist logistics personnel in assessing their capability to perform battlefield recovery operations.

(r) The capability to assess a real or potential impact of NBC events on admin/log would be desirable.

Purpose: To assist the ACofS for Security, Plans, and Operations (SPO) in developing plans and/or contingency operations for combat service support operations in support of tactical operations.

(s) The capability to predict and assess threats to rear area supply resources by priority would be desirable.

Purpose: To assist the ACofS SPO in developing plans and/or contingency operations for combat service support organizations in support of tactical operations.

(t) The capability to predict or assess the impact of a key loss of throughput to the corps operations plan would be desirable; i.e., what impact could a major loss have on incoming assets, and how long a delay would result?

Purpose: To assist the ACofS SPO in developing plans and contingency operations for combat service support organizations in support of tactical operations.

(u) The capability to assess losses of major systems in real-time and loss factors by sectors of the battlefield, would be desirable.

Purpose: To assist the ACofS SPO in developing plans and contingency operations for combat service organizations in support of tactical operations.

(v) The capability to determine the status of medical facility availability is desirable.

Purpose: To assist the Surgeon in determining the requirements and support for tactical operations.

(w) The capability to load the Personnel Requirements Report (PRR) would be desirable. The PRR, rather than the PERSREP, is the report that sustains the force.

Purpose: To expedite the basic report which requisitions replacements sustaining the force.

(x) The capability to extract Joint Operations Planning System (JOPS) planning data from division and non-division units would be desirable.

Purpose: To assist corps operations personnel in accessing division data and preparing the corps daily update to the JOPS plan. This capability is a unique requirements of the XVIII Airborne Corps.

(y) The capability to interface with the Command and Control Information System (CCIS) may ultimately be required.

Purpose: To ensure that the combat service support requirements of the corps are input to CCIS (USAREUR) in a timely and accurate manner.

?. Specific Processing Requirements and Capabilities

(a) Class I Data - Data must be maintained for unprepared rations (type A&B) and prepared rations. The following data items are needed:

- Predicted use/loss
- Density
- Required
- Available for use
- Remarks

} corps records

- Number of meals
- Days of supply
- LOG STAR code

} higher headquarters

(b) Class III Data - Data must be maintained for MOGAS, Diesel, and JP-4. Note that higher headquarters also required JP-5 and AVGAS, which was not reflected at corps. The following data items are needed:

- Projected use/loss
- Density
- Required
- Available for use
- Remarks

} corps records

- Number of gallons or cubic meters
- Days of supply
- LOG STAR code

} higher headquarters

Note: Class III is further complicated by conversion required by higher headquarters. Some reports require gallons; in other cases gallons must be converted to cubic meters. Days of supply is sometimes confusing, because USAREUR data includes only fuel on-hand in depots whereas NATO data includes on-hand supplies plus quantities that subordinate units have as part of their basic load.

(c) Class V Data - Data must be maintained for small missiles, field artillery, and tank ammunition. Seventeen (17) specific munitions are tracked and reported to higher headquarters using SITREP. Data items tracked and reported are:

- Projected use/loss
- Density
- Required
- Available for use
- Remarks

} corps records

- Number of rounds available
- Days of supply
- LOG STAR code

} Conversion to days of supply is required for higher headquarters. NATO data must include units' basic loads.

(d) Class VII Data - Data must be kept for a variable number of weapon systems and equipment. Higher headquarters requires data on 13 force weapon systems and 38 equipment items. The following data items are required:

- Authorized
- On-hand
- Lost
- Cumulative losses
- Operationally ready

} corps records

- Number in GS maintenance
- Number out of GS maintenance in 24 hours
- LOG STAR code

} higher headquarters

(e) Corps Logistics Posture Data - The corps differed significantly on their approaches to briefing the CG, presumably as a function of the individual involved. One corps briefed using multiple briefing charts covering Class VII Replacement/Losses Cumulative, Class VII Replacement/ Losses Daily (same categories), Equipment Availability and Supply Status by DOS. The charts were additionally used to show trends developed by the staff.

The other corps presented one chart covering defined categories for each of its assigned units. For each category, both corps rated each unit fully operational or in need of some degree of support. These ratings were color coded and based on the unit's effectiveness and percentage of availability. Additionally, corps G4 staffs received narrative comments

from the divisions on the following subjects:

- Existing or anticipated deficiencies
- Openings and closings of Class V supply points
- Changes in assignments or locations of major service units
- Changes in locations of other supply points
- Deviations from normal supply points
- Logistics problems for the attention of the corps commander
- Resume of significant accidents, actions and changes having log impact losses, damages, attachment or detachment).

APPENDIX C

Demonstration Briefing Given To
USAREUR Units During Evaluation
of Resource Planning Aid

INTRODUCTION

Army Research Institute

(ARI)

Good morning, I am Steven Stewart, a member of the staff of the ARI Field Unit - Fort Leavenworth, Kansas. LTC Carter is here representing the Command, Control, Communications and Intelligence (C^3I) Directorate, the CACDA element from which the project we are to brief you on today was generated. Dr. Parrish is the Project Head of the Field Unit's co-located contractor, System Development Corporation. We are here to brief you on a concept for a Resource Planning Aid which we (ARI/SDC) have developed that, if implemented in evolving tactical data systems, should greatly enhance the G1/G4 staff's ability to provide more timely and accurate inputs into the tactical decision making process. More specifically, the Resource Planning Aid should allow very rapid and accurate prediction to be made vis-a-vis potential expenditures of personnel, fuel, ammunition, and major end items for a given course of action or for alternative courses of action that are being contemplated. After I provide some background material and LTC Carter outlines the tactical scenario which will provide the context for the demonstration, Dr. Parrish will discuss the Aid in detail.

The primary mission of the ARI - Fort Leavenworth Field Unit is to devise mechanisms that will ultimately improve the ability of commanders/staffs to carry out their combat functions. This problem is being attacked on three broad fronts, viz., through training development activities, experimentation with varying organizational structure and design principles, and identifying and defining job aids and automation assists. Under the auspices of the latter major thrust and in response to a specific CACDA need, the current effort was initiated. To support this need, ARI let a three calendar year contract to SDC which commenced on 8 February 1977. The work which will be described presently was accomplished during the third year of that contract and represents a logical extension of the effort that was expended during the first two contract years.

The general objective and approach of our project are as shown on this slide.

(Slide 1)

The preliminary analysis, accomplished via a literature review and interviews with previous corps staff as well as Admin and Log Center personnel, yielded three candidate job aid descriptions designed to overcome selected performance deficiencies in the admin/log areas. The functions for which the job aid descriptions were developed are ones which can impact heavily on the tactical decision making process and/or the implementation of that process. The general names of the candidate aids are shown on this slide.

(Slide 2)

With the results of the preliminary analysis of these descriptions in hand, we visited V and VII Corps in the April-May timeframe. At both organizations we first conducted what we referred to as an exploratory investigation, i.e., we presented the job aid descriptions to the G1, G4 and G3 and asked them if the functional areas which each addressed could currently be performed to their satisfaction and, if not, would the kind of aid described be of use in improving accomplishment of the function. They were then asked to prioritize the three candidate aids (assuming they saw merit in considering all three) in terms of the order of attention that they should receive in further concept development work. All corps principals felt that the functions addressed by the job aid or automation assist descriptions were extremely important ones and that the notional aids, if fleshed-out, obviously had the potential of improving the performance in the target functional areas. Also, the Resource Planning Aid was perceived as being the most important concept to pursue. (These findings are identical to the findings at the CONUS corps, with only one exception). Since we were not sure which job aid concept would ultimately receive further attention when we visited each organization, while we were there, we conducted an in-depth analysis into each of the functional areas the job aids addressed. In the case of V and VII Corps, a total of 64 G1/G4, and G3 action officers were interviewed. We obtained from them a detailed data base concerning how the functions being addressed are currently performed so as to build a solid foundation for further work.

Based upon our visit here as well as the III and XVIII Corps and the Admin and Log Center visits, and considering the amount of contract sources remaining, a decision was made to pursue fleshing out the Resource Planning Aid concept, capitalizing on the methods developed during the previous year plus the Admin and Log Centers' work in the forecasting area and/or developing new data processing methods as might be appropriate.

(Slide 3)

Assumptions

In summation and to reiterate, the purpose of this briefing is to acquaint you with the now "fleshed-out" Resource Planning Aid concept. To achieve this end, LTC Carter will describe the scenario we have chosen to provide the context for demonstrating the methodology. Following these stage setting activities, Dr. Parrish will discuss the methodology and/or Resource Planning Aid concept in some detail. We would like very much for you to comment on the concept after the presentation as a way of satisfying the last bullet I showed you on the methodology slide, i.e., "Evaluating the Resulting Methodology" or our work during the past year. Remember the assumptions that I've stated. They're terribly important vis-a-vis understanding and responding to the remainder of the briefing. Do you have any questions before we proceed?

Slide 1

RESOURCE PLANNING AID DEVELOPMENT EFFORT

Objective:

- Improve tactically relevant CSS functioning at corps level

Approach:

- Conduct preliminary analysis of corps G1 and G4 functions
  - Literature review
  - Interviews with CAC personnel with corps staff experience
  - Visits to Admin and Log Centers
- Conduct exploratory investigation and in-depth analysis
  - Interviews with III, V, VII and XVIII Corps G1, G3, and G4 staffs
- Extend previous methodology and/or develop new data processing methods
- Evaluate resulting methodology

Slide 2

PRELIMINARY ANALYSIS RESULTS/ FUNCTIONS SELECTED FOR FURTHER WORK

- Resource Planning Aid (status data, shortfalls, asset planning)
- Force Composition Planning Aid (force structure planning and task organization)
- Battlefield Dispatch Assistance (weapon system status and dispatching)

Slide 3

ASSUMPTIONS

- Validity of the consumption/attrition forecasting formulae and factors
- Communications available to support near real time entry of status data
- Where the application should reside within the ABIC/AC^{2}MP
- Scenario and tactics
- Classes of supply (III, V, VII) and people
- Size of computer/HW needed to support the application

TACTICAL SITUATION

Combined Arms Combat

Developments Activity

(CACDA)

(Slide 4)

The resource planning methodology requires selected facts and pertinent estimates as illustrated on this slide. The methodology processes these inputs using factors from published sources or current experience. The result is a forecast of the cost of a given course of action in terms of casualties, consumption of fuel and ammunition and probable loss of weapon systems. The information thus derived can assist the commander and staff members by projecting more detailed comparisons for consideration.

(Slide 5)

For our demonstration of the methodology in assimilating comparative data, we selected the classes of supply shown on this slide, as well as CONUS unit TOE strengths.

We feel that these classes of supply and the major end items, while not all encompassing, are representative of the more critical and provide a valid test bed for the methodology. Those items shown are related principally to the combat and combat support elements within our scenario.

The tactical scenario we are using has been taken from one prepared by the Command and General Staff College. It has an offensive scenario of counter-offensive proportions which permits us to assume that much of the pre-stocked supplies has been consumed during the previous defensive actions. The other assumptions we made are that: (2) applicability of the methodology will be used primarily by those formulating input to the commanders estimate although other uses may be derived later. (3) Procedures which are presently too slow in passing essential data through channels will become sufficiently improved so as to support the use of this methodology, and finally, (4) as the methodology is applied at successively higher headquarters, the quality of electronic transmission of data and the maintenance of the required data base will result in a quality product which is reliable.

(Slide 6)

To set the stage for the facts and estimates used, the Warsaw Pact forces initiated offensive actions against the NATO forces with the objective of securing industrial and port complexes within West Germany. As their forces were positioned for their attack, intelligence sources identified the threat which resulted in dual based US units being deployed to Europe. Our principal player is the fictitious 10th Corps which occupies terrain approximating that of V corps. As shown, the Warsaw Pact has developed salients which the FRONT commander has elected to exploit. All actions have been non-nuclear.

(Slide 7)

Within 10th Corps, the enemy forces opposing us have been those making their attack and as a result are at approximately 60-70% strength in personnel and weapon systems. One armored division, one mechanized infantry division and one armored cavalry regiment comprise the friendly elements on the line of contact. They are at an approximately 80% strength. Deployment of two additional mechanized infantry divisions and one armored division from CONUS is substantially complete. Overall corps strength is 85%.

The next fact we enter is the mission for our player corps. CDR, Allied Forces Central Europe (AFSCENT), has ordered a counteroffensive to restore the international boundary and to be prepared to either continue the attack or to assume defensive positions along the border.

(Slide 8)

Using a map to make a terrain study of the geographical area to be traversed, we identify five axis which may be used for our attack. Avenues A and B provide the greatest amount of maneuver room for battalion sized formations. There are defiles on both which can be used by the enemy for defensive positions. Alsfeld, on Ave B, is the only large town and it can be bypassed.

Avenue C provides less maneuver room and has more pronounced defiles than A or B. This axis has no large towns and provides sufficient room to bypass numerous small villages. Avenue D is the most direct route to the international boundary but encounters the urban sprawl of Fulda which can become very restrictive.

The last, Avenue E is the most restrictive of the five and encounters steep slopes, forests and the urban sprawl south of Fluda.

(Slide 9)

Using templating techniques which are doctrinal and situational in conjunction with the enemy units we have identified, we project that enemy forces will be encountered along each axis as shown. Elements of a tank division and remnants of a fifth motorized division are shown in the second belt. Assuming that our attack is imminent, the enemy will have two to three days to prepare defensive positions and has had no opportunity to establish a security belt. Therefore, our forces will encounter the main defensive belt in the initial stages of the attack.

(Slide 10)

Our task organization for course of action 1 is shown on this slide. Of the five field artillery brigades, two have been stationed in 10th Corps as part of the NATO contingent. The other three were deployed from CONUS prior to the dual-based divisions. All have seen action and are at 80% strength in personnel and equipment.

(Slide 11)

For course of action 1, the main attack is conducted with two mechanized divisions to penetrate the main and second defensive belts on avenues A and B respectively. On order, an exploitation to the international boundary will be conducted with the two armored divisions. The armored cavalry regiment conducts a demonstration on Ave C, and a mechanized infantry division conducts a supporting attack on Avenues D and E.

(Slide 12)

Advantages and disadvantages on this course of action which have a bearing on the resource planning aid methodology are shown on this slide. For example, the mutually supporting divisions can make more efficient use of available artillery ammunition which could be constrained in certain types; and those divisions making the main attack or travelling along Avenues A and B will consume more fuel than if a shorter route were traversed.

(Slide 13)

The task organization for our second course of action is shown. For quick comparative purposes, changes from the previous task organization are color coded; blue indicating an added capability, red indicating a reduced capability.

(Slide 14)

In course of action 2, the main attack is made on Avenues C and D by one mechanized division on each. On order, the armored division of Ave C conducts an exploitation to the international boundary. The armored cavalry regiment on Avenue D has the mission of following and supporting the mechanized division. Supporting attacks are accomplished by an armored division on Avenues A and B and a mechanized division on Avenue E.

(Slide 15)

The advantages and disadvantages as they bear on resource planning aid methodology are shown on this slide. Once again, although these are tactical implications, our use is to develop consumption and attrition forecasts.

(Pause)

These two courses of action formulate the basis for the application of the resource planning aid methodology. The subsequent products may be useful in forecasting potential critical weak-links within the commands' elements. We envision the possible use of the methodology in the "Stubby Pencil" or programmable calculator mode at battalion level using data obtained through existing reports. At each successive higher headquarters, efficient use must incorporate reliable communication and an increasingly larger data base which maintains currency of the information.

I will be followed by Dr. Parrish who will explain the methodolgy.

METHODOLOGY OVERVIEW

FACTS

- STATUS OF FRIENDLY FORCES
- TERRAIN
- MISSION
- ROAD MOVEMENT DISTANCES

ESTIMATES

- STATUS OF ENEMY FORCES
- COMBAT INTENSITY
- DURATION OF COMBAT INTENSITY
- COMBAT MOVEMENT DISTANCES

FACTORS APPLIED IAW RESOURCE PLANNING AID METHODOLOGY

FORECAST OF THE COST OF SPECIFIC COURSE OF ACTION IN TERMS OF CASUALTIES, FUEL AND AMMO CONSUMPTION, AND LOSS OF SELECTED WEAPONS SYSTEMS

CLASS OF SUPPLY FORECASTED

CLASS III BULK

DIESEL
JP-4
MOGAS

CLASS V

81MM
105MM (TANK)
155MM
8IN
TOW

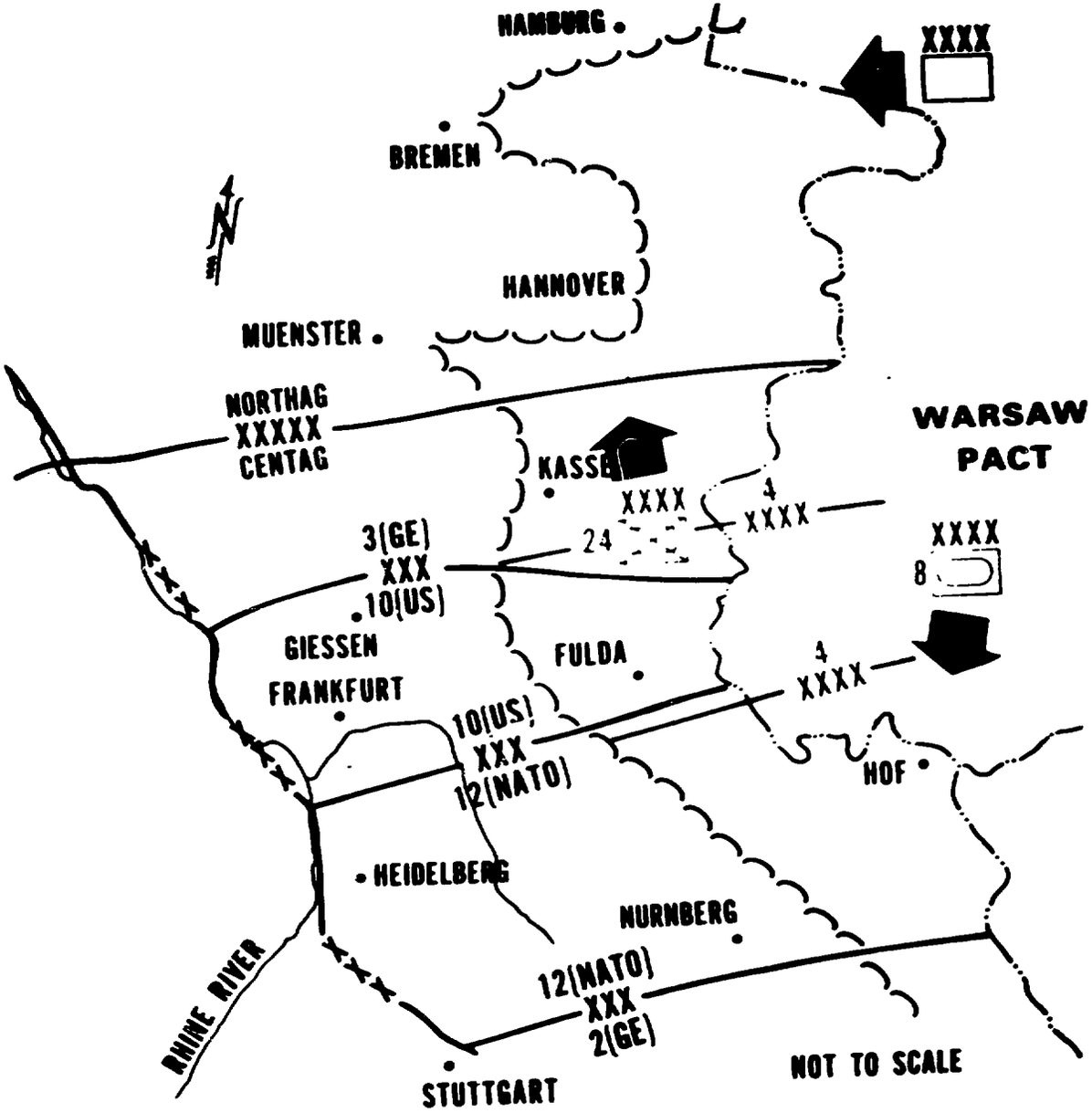
CLASS VII

VII A
HELICOPTER, ATTACK
HELICOPTER, OBS
HELICOPTER, UTILITY

VII B
COMPRESSORS
GENERATORS

VII K
AMBULANCES
TRUCK, CARGO
TRUCK, FUEL SERVICING
WRECKERS

VII O
CARRIER, 81MM
CARRIER, 4.2IN
CARRIER, CMD POST
CARRIER, GM (TOW)
CARRIER, PERS
HOWITZER, SP 155MM
HOWITZER, SP 8IN
RECOVERY VEH, LIGHT
RECOVERY VEH, MEDIUM
TANK, 105MM, BATTLE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CENTAG
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3(GE)
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10(US)
24
XXXX
8
GIESSEN
FRANKFURT
FULDA
4
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10(US)
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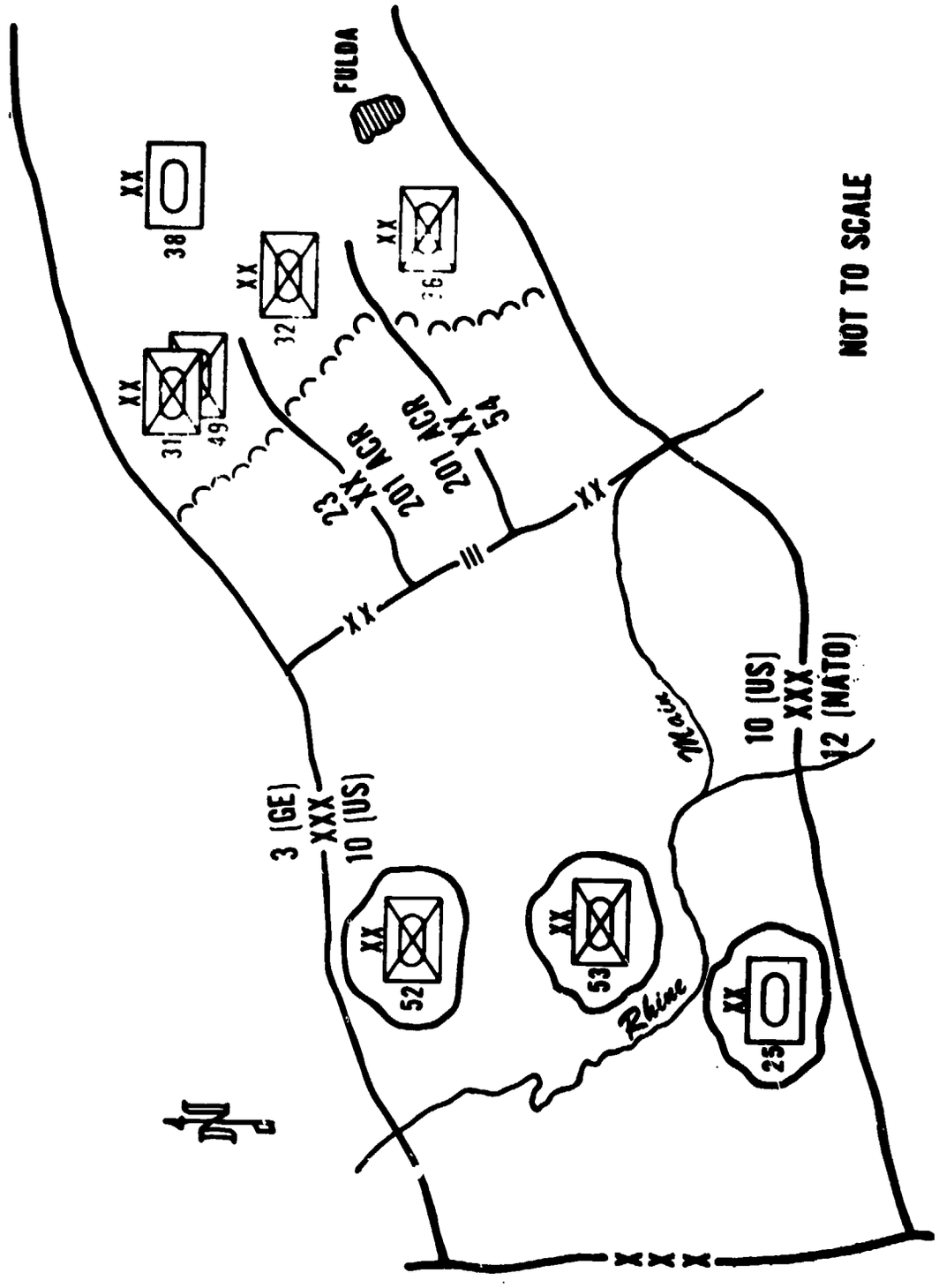
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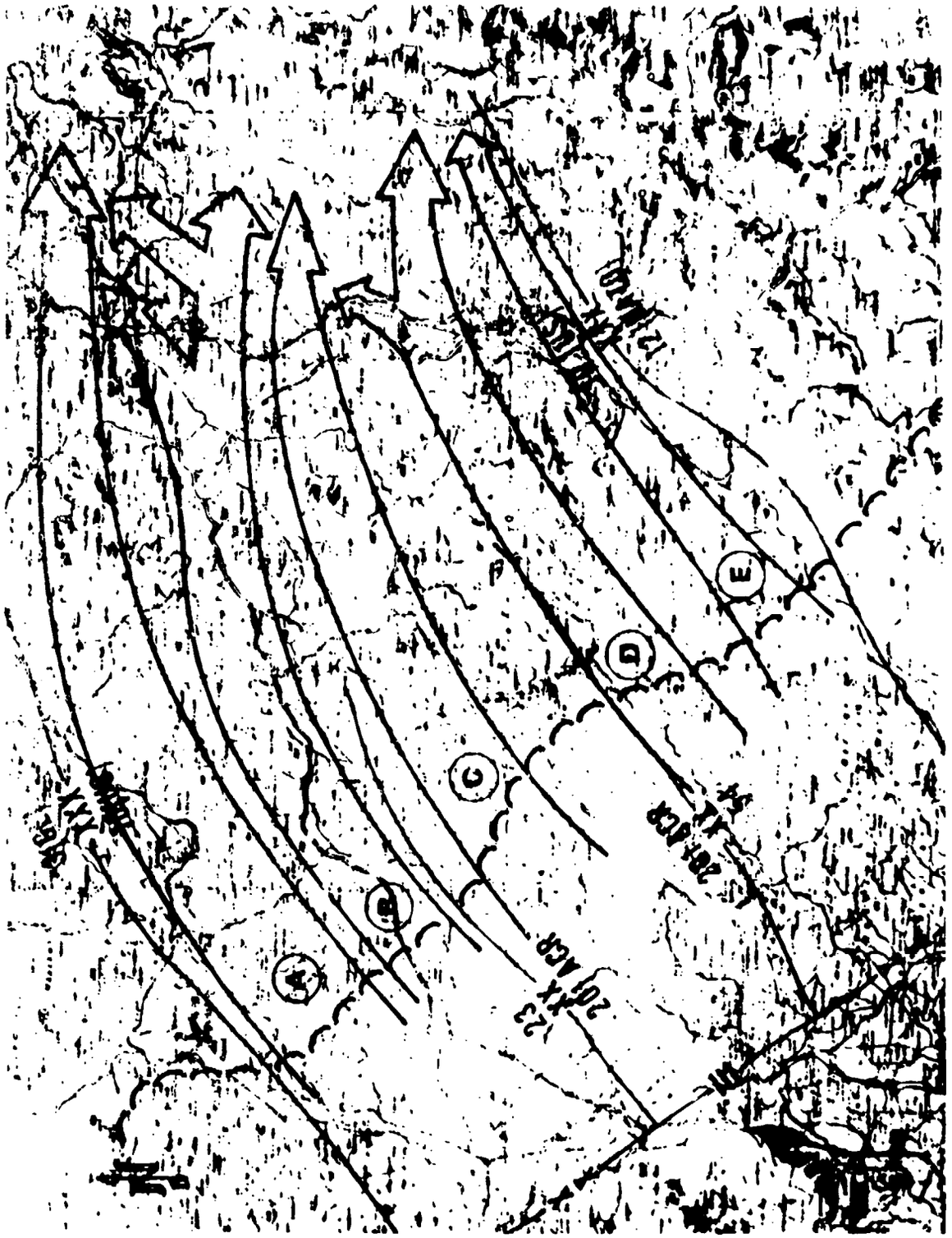
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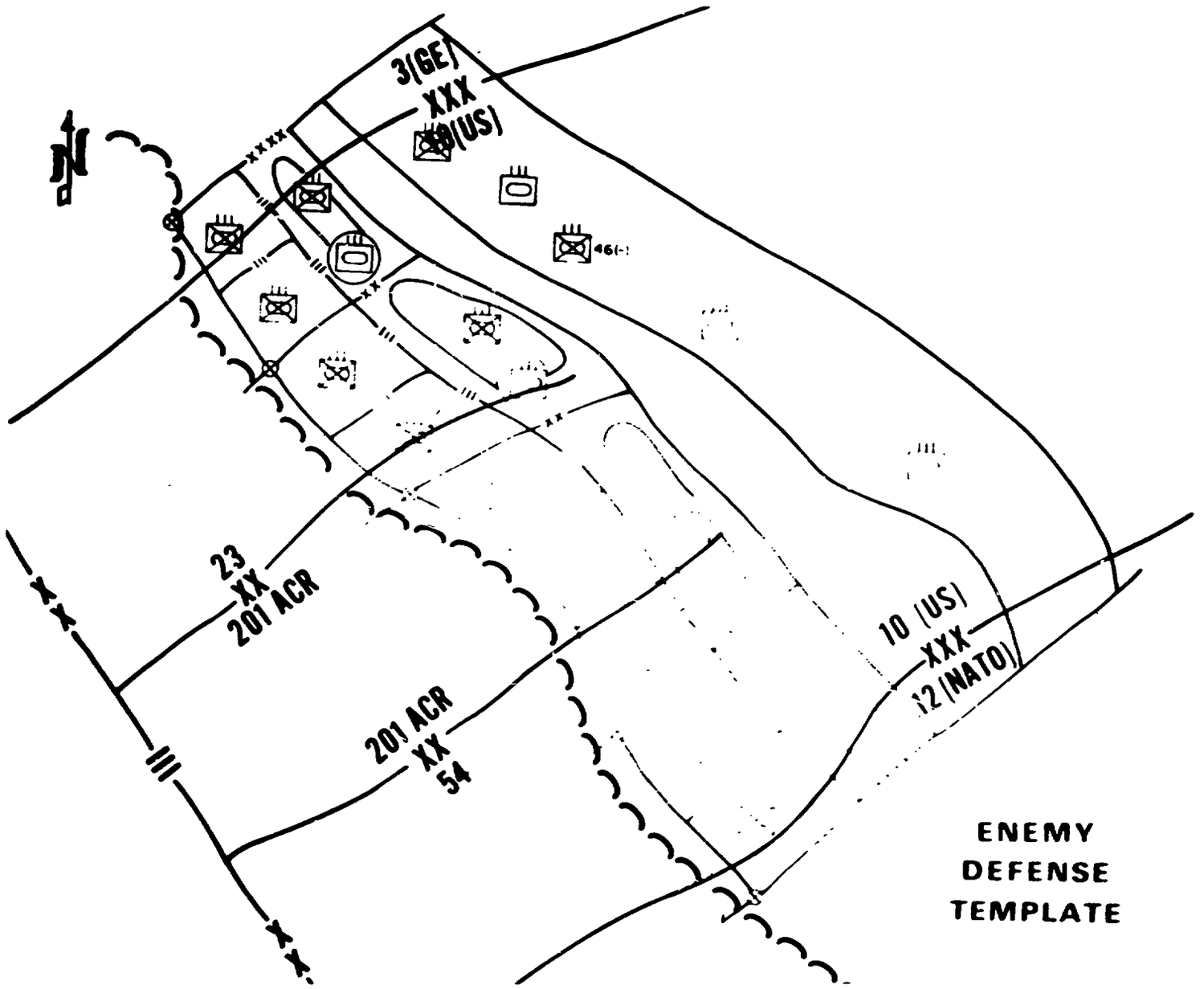
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201 ACR
XX
54
10 (US)
XXX
12 (NATO)
ENEMY
DEFENSE
TEMPLATE

TASK ORGANIZATION

COURSE OF ACTION-1

52D MECH
- FA BDE (ATTACHED)
  - 2 BNS, 8"
  - 3 BNS, 155MM
- HAWK BN (DS)
- ENG CBT BN (OPCON)

53D MECH
- FA BDE (ATTACHED)
  - 2 BNS, 8"
  - 3 BNS, 155MM
- HAWK BN (DS)
- ENG CBT BN (OPCON)

23D ARMD DIV
- ENG CBT BN (OPCON)

25TH ARMD DIV

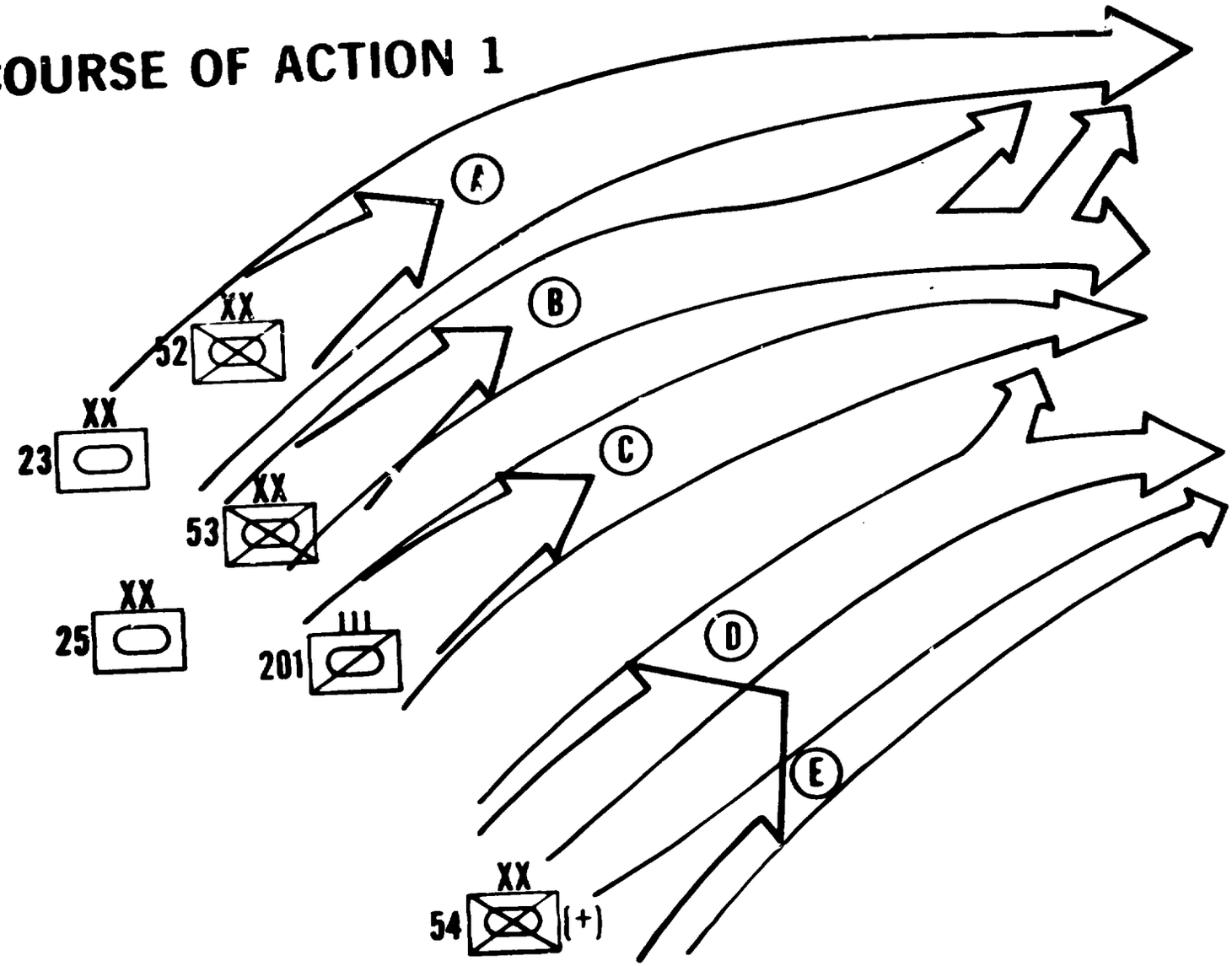
171ST ACCB

54TH MECH
- MECH BDE (ATTACHED)
  - 2 MECH BNS
  - 1 TANK BN
  - 1 FA BN, 155MM
- FA BDE (ATTACHED)
  - 3 BNS, 8"
  - 2 BNS, 155MM
- PROV ENG GROUP (OPCON)

201ST ACR
- HAWK BN (DS)
- ENG CBT BN (DS)

CORPS ARTY
- 2 FA BDES
  - 5 BNS, 8"
  - 4 BNS, 155MM
  - 3 BNS, LANCE

COURSE OF ACTION 1



COURSE OF ACTION 1

ADVANTAGES AND DISADVANTAGES BEARING ON RESOURCE PLANNING AID METHODOLOGY

ADVANTAGES:

- DIVISIONS MAKING MAIN ATTACK CAN BE MUTUALLY SUPPORTING.
- AVENUES OF MAIN ATTACK OFFER BEST MANEUVER TERRAIN
- SUPPORTING ATTACK FIXES THE BULK OF TWO ENEMY DIVISIONS.
- MAIN ATTACK ENCOUNTERS THE MORE SEVERELY ATTRITED ENEMY UNITS.
- MASS CAN BE ACHIEVED ON A NARROW FRONTAGE.
- 52D AND 53D MECH DIVS CAN MOVE ON MOST DIRECT ROUTE TO LINE OF CONTACT.

DISADVANTAGES:

- AXIS OF MAIN ATTACK IS NOT THE SHORTEST TO THE BORDER.
- 25TH AD MUST MOVE A GREATER DISTANCE TO LINE OF CONTACT.
- THREE DIVISIONS ARE MASSED PRIOR TO ATTACK THUS MAKING THEM MORE VULNERABLE TO ENEMY STRIKES.
- THE MAIN AND SUPPORTING ATTACKS ARE NOT MUTUALLY SUPPORTING.
- ATTACKS HIT THE ENEMY STRENGTH IN TERMS OF NUMBERS OF UNITS.

TASK ORGANIZATION
COURSE OF ACTION 2

52D MECH
- FA BDE (ATTACHED)
- HAWK BN (DS)
- ENG BN (OPCON)

53D MECH
- FA BDE (ATTACHED)
- HAWK BN (DS)
- ENG BN (OPCON)

54TH MECH
- MECH BDE (ATTACHED)
- FA BDE (ATTACHED)
- PROV ENG GP (OPCON)

25TH ARMD DIV

171ST ACCB

23D ARMD DIV
- FA BDE (DS)
  - 2 BNS. 8"
  - 2 BNS. 155MM
- HAWK BN (DS)
- ENG BN (OPCON)

201ST ACR
- ENG BN (HAWK BN)

CORPS ARTY
- FA BDE (FA BDE)
  - 3 BNS. 8" (2 BNS. 8
  - 2 BNS. 155MM (2 BNS. 155MM)
  - 3 BNS. LANCE

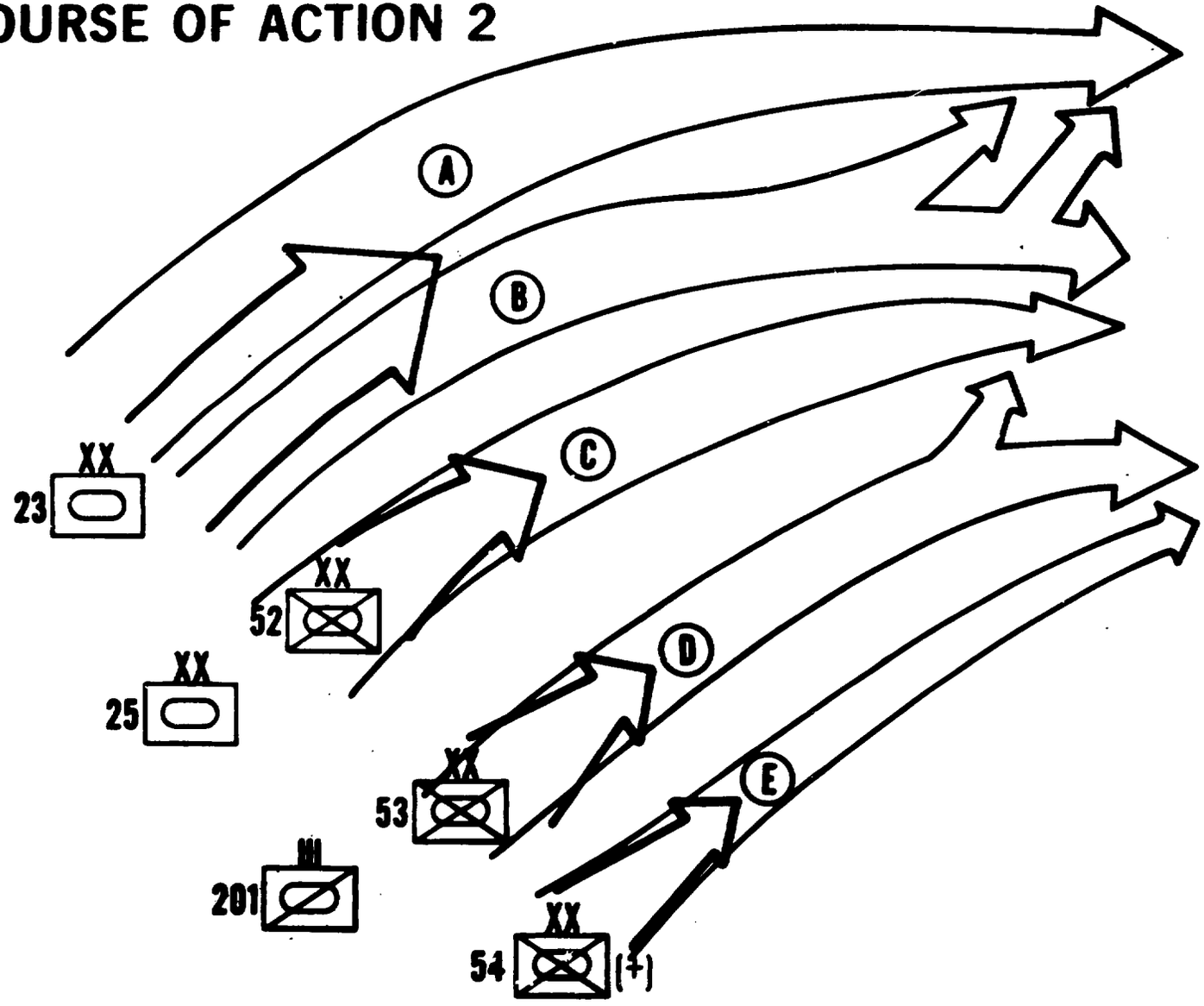
LEGEND

COMPARISON TO TASK ORGN 1

 – ADDED CAPABILITY

 – REDUCED CAPABILITY

COURSE OF ACTION 2



COURSE OF ACTION 2

ADVANTAGES AND DISADVANTAGES BEARING ON RESOURCE PLANNING AID METHODOLOGY

ADVANTAGES:

- MAIN ATTACK TAKES SHORTEST ROUTE TO BORDER.
- POTENTIALLY FEWER ENEMY REGIMENTS ALONG ATTACK ROUTE.
- SUPPORTING ATTACK FIXES BULK OF ENEMY UNITS.
- MAIN AND SUPPORTING ATTACKS CAN BE MUTUALLY SUPPORTING.
- MORE DISPERSION IN ASSEMBLY AREAS AND WHILE MOVING TO CONTACT
- 25TH AD HAS A MORE DIRECT ROUTE TO LINE OF CONTACT.

DISADVANTAGES:

- AVENUES OF MAIN ATTACK ARE SEPARATED BY TERRAIN FEATURE.
- TERRAIN PROVIDES LESS POTENTIAL FOR MANEUVER.
- 52D AND 53D MECH DIVS HAVE A LONGER ROAD MARCH TO LINE OF CONTACT.
- ONE ARMORED DIV DESIGNATED FOR EXPLOITATION, POSSIBLY CONTRIBUTING TO A GREATER ATTRITION OF WEAPONS SYSTEMS WITHIN THAT DIVISION.

THE METHODOLOGY

System Development Corporation

(SDC)

I'd like to begin my part of this presentation with a reminder. What we're demonstrating today is a conceptual description of a computer methodology. Depending on economics, the future direction of Army automation, and in very large part on your reactions to it, this methodology may someday become a part of tactical data systems. As such, we believe it will contribute to the commander's tactical decision process. However, the methodology is intended for direct use primarily by the G1 and G4, and possibly by the S1 and S4 at lower echelons. Its purpose is to help the one and the four cope with the information retrieval tasks and the numerical computations required to generate forecasts. In this way, we believe it will facilitate their task of providing the commander with some of the information he uses in making his decisions. It may serve another purpose as well: to help the one and the four carry out their own planning responsibilities once the commander's decision is made. However, our focus today will be on input to the decision process.

The methodology capitalizes on concepts that we learned about when we visited the Admin and Log Centers late last spring. Both centers are engaged in programs to develop new planning methods in their respective areas.

(Slide 16)

The Admin Center is developing a model for distributing losses by MOS and grade. They plan to use it to update FM 101-10-1. I should mention that the term "operational factors" in this model actually will include several variables. The project staff was still working on these variables when we briefed them on the methodology a few weeks ago. For that reason we're not sure just what they'll be, although we understand they'll have factors at least for types of operations, for weather, and for terrain.

A follow-on effort will try to develop a proability model for predicting casualties. The model on this slide computes total losses, and then distributes them into various categories. Basically, it's a "top-down" model. Now they want to develop a "bottom-up" model. The idea is to discover the probability of a casualty, given information about operational factors, and about grade, branch or functional area, and MOS or SSI.

Meanwhile, at the Log Center, they're developing planning methods for every class of supply except I and VI. When we visited the Center, they had just started work on Class VII.

(Slide 17)

These are the formulas that they use to compute fuel consumption for the various types of Class VII equipment. The slide is fairly straightforward, so I won't comment on it unless someone has a question. (PAUSE) We don't have a slide for ammo consumption or equipment losses, because they're quite

simple. For ammo forecasting, they use density times firing rate. For equipment, they use density times a loss factor for the particular item.

The Admin and Log models have a couple of implications that I should bring out. One is that they demand a substantial data base.

(Slide 18)

The slide shows the requirements for that data base. At the time we began development of the methodology, the Admin and Log Centers were still working on the planning factors to be used in computing forecasts. When we briefed this presentation at the two Centers, we learned that these efforts are still underway. For that reason -- and also to keep this briefing unclassified -- we used unclassified factors derived from sources at Fort Leavenworth.

In any case, the methodology, itself is not dependent on the specific factors that are used. Other factors could easily be plugged into it, as appropriate. As a matter of fact, one of the capabilities of the methodology is that it allows the user to change factors at will. In this way, he can play "what if" games and thereby explore contingencies. A very interesting exercise would be to plug in the factors that you use here, and to compare the results from the methodology with results you may already have on hand.

The other implication of the models is the necessity for status information. Every model that I've mentioned uses density. Therefore, the models -- and the methodology -- need the numbers of personnel currently available and the numbers of equipment items currently op ready. That brings up an issue. In developing the methodology, we assumed data collection and data processing capabilities that are planned for the mid-1980's. For example, we've assumed the availability of the Division Level Data Entry Device (DLDED), which would permit direct entry of Admin/Log data from the battalion level. Another example is the Combat Service Support Control Program. This project is just getting underway, so not too much is known about it. However, the Program will provide an interface between admin/log systems and tactical command and control systems. The CSS Control Program would provide the access to status data in future admin/log systems that the methodology needs. In that case, the data base itself would only have to be loaded once, at the time of initialization. Thereafter, it could be maintained automatically. The user would then have to enter only the information that would be unique to the organization and its current mission. Advances such as the DLDED and CSS Control Program imply a considerably improved communications capability, of course. In that regard, EW also becomes an issue. There again, we understand efforts are underway to improve the situation.

Notwithstanding these assumptions, the methodology itself is not necessarily tied to any particular computer system, either existing or planned. As LTC Carter mentioned, the methodology could be restructured to make it useable in a "Stubby Pencil" or programmable calculator mode at the level of brigade or battalion. For that matter, it clearly is within state-of-the-art computer technology, although it would probably require some modification. We haven't looked at these alternatives in any detail, for reasons that Steve Stewart mentioned earlier.

(Slide 19)

I'd like to show you a portion of the master equipment data base that we used in constructing our demonstration. The sequence number is purely for convenience in locating particular equipment items. It has no meaning otherwise. The line number is from the TOE, of course. The group number is used to collect different items into meaningful groups. In actual use the different groups would be defined in accordance with the individual commander's guidance.

The scenario did not include that guidance so we adopted the groups that LTC Carter showed you on an earlier slide. The rest of the columns contain the kinds of information listed on the preceding slide; that is, it shows fuel and ammo types, and use and consumption factors. While we're on this slide, I should point out something about those factors. Our scenario calls for an attack, so our factors reflect only attack rates. In actual practice, of course, the data base would contain factors for all types of operations.

The methodology uses a "bottom-up" approach. That is, it generates forecasts for lower echelon units and then rolls them up for higher echelons. In theory, it could start with any echelon. For our demonstration, we chose to start at battalion level. Using the general data base, we constructed a unit data base for each of the battalion level units in the CGSC scenario.

(Slide 20)

The slide shows an abbreviated data base for a tank battalion. There wasn't room on the slide to show all the fuel burners, so we're showing only a few of them. And, of course, we added personnel to the unit data base. The personnel are shown at the bottom of the slide, broken out by 15 branches and three grades. As with equipment, the branches could be grouped in any way the commander desired. In our case, we grouped them into combat, combat support, and combat service support. Also, since analysis of the scenario indicated a three-day operation, we dropped ammo rates for protracted periods of conflict.

There wasn't time to construct a data base like this one for every unit in the corps. So, we constructed one for as many different types of units as we could. As LTC Carter mentioned, we concentrated on maneuver and combat support units, although we did get in some of the combat service support as well. In a real application, of course, the data base would include the whole corps. We didn't have sufficient information to provide status data for each unit, either. So, we constructed each data base at TOE strength. Then we made an assumption that was also convenient for computational purposes. If a division was at, say, 80% strength, we assumed that every unit in the division was at 80% strength also.

(Slide 21)

Once we had the data base constructed, we ran it through the methodology on a computer. We used the scenario for guidance in the methodology's inputs, which are shown on this slide. In a real situation, most of the inputs would be generated by commander and staff interaction. A minute ago, I mentioned that analysis of the scenario indicated a three-day operation. For convenience, we broke it down into four twelve-hour intervals and a final 24 hour interval. In practice, the length of an operation could be broken into as many or as few intervals as desired. Then, for each interval, and for each course of action, the methodology needed the other inputs indicated on the slide. All of the other required information was either in the data base or in the program itself.

After we input the unit and mission data, the methodology reduced unit TOE strengths and densities to levels specified in the scenario. It then used the Log models to generate discrete forecasts. That is, it generated a separate loss or consumption forecast for each item of equipment, fuel, and ammo.

For personnel, we took a different tack. The Admin Center is still working on its "bottom-up" probability model, so we fell back on our own devices to generate the discrete forecasts for personnel. Basically, we accumulated TOE strengths for the whole corps and plugged in factors from FM 101-10-1 to get total casualties. Then we distributed those casualties according to the FM 101-10-1 update model that you saw a few minutes ago. Next, we used these distributed casualties to determine empirical probabilities for each branch and grade. Because of time limitations, we did not carry this procedure to the level of MOS and SSI, although the procedure itself is the same.

Finally, we plugged these empirical probabilities into the methodology for use in generating discrete personnel loss forecasts.

(Slide 22)

Here's an example of each type of discrete forecast. These are strictly freehand drawings that are symbolic rather than based on actual computations. The reason for that is that these are loss and consumption forecasts. The methodology normally will present information in a different form, as we'll see shortly. Also, the one and the four aren't going to see minutely detailed forecasts like these. At least, not unless they specifically ask for them later. The methodology generates these detailed forecasts for its own use. The next slide shows how it uses them.

(Slide 23)

The first block of this simplified flow chart indicates the generation of the detailed forecasts that were illustrated on the previous graph. The second block rolls up discrete forecasts from units at lower echelons to the echelon required by the user.

The third block collects discrete forecasts into the groups that were defined according to the commander's guidance. I should emphasize that the methodology is flexible in group definitions. It will arrange equipment and personnel into any groups the commander desires. In fact, the one and the four can also define groups for their own purposes, so long as they don't violate the commander's guidance. Thus, now, for example, instead of a separate forecast for M60A1, M113A1 and the like, you've got a forecast for combat vehicles. You can see other examples on the slide.

The fourth block converts those group loss or consumption forecasts to what we've called availability forecasts. The slide shows that this is a straightforward computation.

In the fifth block, the methodology converts numbers of available assets to percentages of remaining capability, based on allocations of fuel and ammo, and on authorized levels of personnel and equipment. The reason for using percentages is to allow the one and the four to compare apples and oranges, as we'll see in a moment.

The sixth block organizes the various discrete forecasts by major categories. That is, the methodology figures out which forecasts are for equipment, which are for personnel, and so on.

Next, it looks at the groups in each major category. Once again, it's looking at those groups that were defined by commander's guidance, or by the one and four in the absence of specific guidance. It determines which group in each category has the lowest percentage of remaining capability.

(Slide 24)

The next slide shows an example of this procedure for equipment groups. You can see that, for each interval, the lowest percentage of remaining capability is circled.

Finally, although it didn't show on the previous slide, the methodology repeats the procedure for each of the time intervals specified by the user. And then it plots the results.

(Slide 25)

Here's an example of what the output might look like for the corps as a whole. This slide assumes a computer graphics capability, of course, but the results could be presented in a tabular form if necessary. In fact, our computer had no graphics capability, so we got tabular output and then drew the graphs. And maybe I should emphasize that all of the slides you'll be seeing from here on show results from those unclassified factors we obtained at Fort Leavenworth.

You can see that only the major categories are plotted on the slide. But there's another feature of the slide that's not so obvious. Each line represents the worst case for that particular category. For example, take the green line with triangles that represents equipment. Each triangle for an interval portrays the equipment group that had the lowest percentage of remaining capability for that interval. As you saw on the previous slide, different triangles can represent different groups. In fact, each of the triangles could represent the percentage remaining for a different group. Or, they could all represent the same group. The same idea applies to fuel, ammo, and personnel.

Granted, you can't tell from this slide which equipment group is the worst case for any given interval. The same is true for personnel groups, and for fuel and ammo types. But these kinds of information represent another level of detail. The purpose of this slide is to present an overall picture of the Admin/Log costs for each course of action. By comparing the upper and lower graphs, you can see very quickly that the two courses don't differ very much in that regard. That's not to say that such costs would not differ in another scenario, with different courses of action. In any event, this slide shows clearly that the commander needn't worry too much about consumption of assets in <u>comparing</u> courses of action.

On the other hand, the slide shows more than just a comparison of Admin/Log costs between the two courses. For example, a glance at this slide is all you need to see that every major category falls below the critical level of 70 percent. Incidentally, we chose that critical level because we understand it's an Army standard. However, the methodology is flexible, and that level could easily be established by commander's guidance.

In one sense, the slide is an unfortunate example of the methodology's "worst case" overview capability. Because the slide doesn't dramatize the aid that the capability gives to the one and the four to manage information by exception. For example, suppose that the ammo line had not dropped below 70 percent. Because the slide shows worst case, the four and the fire support coordinator would know they needn't worry about ammo for the coming operation. They could focus their attention on other categories.

Be that as it may, the overview slide shows pretty clearly that the one and the four need to dig out more detailed information before they talk to the commander. The particular order in which the four looks at equipment, fuel, and ammo is largely a matter of choice. Also, the four can choose to look at equipment groups, or at specific equipment items. And, if there's an ammo type associated with a particular equipment item, he can either look at it separately, or put it on the same slide with the item. The next slide is an example of ammo presented separately.

(Slide 26)

The slide shows 8" ammo for the two different courses of action. As you can see, 8" consumption hardly differs at all between the two courses of action. However, availability falls below 70 percent shortly after the beginning of the third day of the operation. If the four or the fire support coordinator wished, this information could be displayed in a tabular format as actual numbers of rounds, or even as short tons. However, let's look at another display.

(Slide 27)

I mentioned that the methodology will allow the four to display an ammo type with its associated equipment. Here's an example, the slide shows that 155 howitzers will drop below 70 percent around the end of the second day, but 155 ammo won't approach that level until the end of the operation. Incidentally, a comparison of 155 ammo on this slide with 8" ammo on the previous display might suggest to the four or the fire support coordinator that they should recommend adjustments in firing rates.

The graphs on this slide and the previous one present a direct comparison of courses of action 1 and 2. To compare ammo and equipment on this slide, you have to look from one graph to the other. In some situations, a direct comparison of equipment and ammo might be preferable. The methodology has that capability, as you can see on the next slide.

(Slide 28)

As with the 155's, 105 ammo won't be a problem during the operation, but again, the tanks themselves will be. And you can see from the two graphs that this is the case regardless of the course of action.

Now, let's take a look at the fuel situation.

(Slide 29)

The slide isn't very encouraging, is it? By the end of the first day of the operation, regardless of the course of action, 10th Corps is below 70 percent for MOGAS and Diesel fuel. Even worse, it runs completely out of JP-4 before it's half-way into the second day of the operation.

Having looked at this slide, the four might decide to take a look at his incoming fuel in some detail. And because of the apparent severity of the problem, he might choose a tabular display for more precision than he'd get graphically.

(Slide 30)

According to the scenario, the four can expect to be getting about half a million gallons of fuel a day during the operation. He also knows that his allocation will be composed of about 10 percent MOGAS, 40 percent JP-4, and 50 percent Diesel. The table on this slide shows that those deliveries won't even come close to satisfying the corps requirements. So he knows he's got a problem in either course of action.

What we've shown on these slides are two extremes of the methodology's capabilities for equipment, ammo, and fuel forecasting. On the one hand, the four has the overview that shows him what to expect for the major categories. On the other hand, he has very detailed forecasts, showing predictions for specific items of equipment or specific types of fuel or ammo. In between he could also look at particular groups that he's defined in accordance with the commander's guidance To save time, we aren't showing any displays of the latter type in this demonstration.

The same capability exists for personnel. First, the one can display a gross forecast for the entire personnel roster, as you saw on the overview slide. Then he can break down the gross forecast into successively finer levels of detail, as necessary.

(Slide 31)

For example, this slide represents the next lower level of detail from the overview. The slide shows that all grades dip close to the critical level of 70 percent, although none of them actually drop below it. However, this is not the whole picture, as we can see on the next slide.

(Slide 32)

At the same level of detail, we can look at the data recast in terms of groups defined in accordance with the commander's guidance. As you can see, combat service support strength stays above the critical level throughout the operation, and so does the strength of the combat support group. But the combat group is at or below the critical level by the end of the second day. And, the slide shows that course of action 2 is somewhat harder on the combat elements than is course of action 1.

At a finer level of detail, the one might want a simultaneous breakdown of both grades and groups.

(Slide 33)

That would make a pretty complicated graph, so he might choose to use a tabular format instead. Here's an example of what such a tabular display might look like. You have to study this slide a little while to see them, but several implications emerge from the data. Generally speaking, course of action 2 is rougher on officers and enlisted soldiers in the combat group than is course of action 1. The two courses have about the same impact on casualties among officers and enlisted men in the combat support group. However, warrant officers in this group have it rougher in course of action 2. But now look at the combat service support group. Once again, the warrant officers have a somewhat rougher time in course of action 2, but the striking thing is that course of action 1 results in more casualties to officers and enlisted soldiers than course of action 2. The differences are only about four or five percent, but the data are exactly the opposite of those for the combat group.

(Slide 34)

Finally, for our purposes today, the G1 might wish to look at a particular branch or functional area. Furthermore, he might want to look at a specific grade. In that case, he'd call up a display like this one, which portrays percentages of remaining capability for enlisted infantrymen.

So far, all the examples we've shown you have been focused at the level of corps. And so far, we've concentrated on demonstrating the capabilities and flexibility of the methodology. I'd like to finish my part of the presentation with an example of how the methodology might contribute to the integration of data, and to the evaluation of courses of action in terms of their admin/log

costs. This final example looks at the corps' divisions rather than at the corps as a whole. It focuses on tank losses, although I'm sure you'll be able to see very easily as we go along that it could focus on any assets the user might choose. To introduce the example, let me review briefly the mission and some of our assumptions and conditions.

The mission is to attack and penetrate the main and second defensive belts. Then, on order, exploit to the international boundary. Upon reaching the international boundary, prepare to defend or to continue the attack.

Our assumptions and conditions are as follows.

First, the 70 percent level of remaining assets is a critical consideration to the commander.

Second, this is a worst case projection. That is, we assumed the highest battle intensities and the longest durations of intensities that were consistent with reason. Losses shown are operational losses, and the lost items no longer consume or expend supplies.

Third, the main attack must penetrate the second belt not later than a day to a day-and-a-half after the operation begins. We assume that if the effort took longer than that, the enemy force would have an opportunity to reinforce.

Fourth, mass for the main attack will be achieved locally in both courses of action, with the greatest mass being achieved in course of action 1.

Finally, detailed opposing force ratios were not included in determining battle intensity or degradation factors.

(Slide 35)

Now, here are the salient features of the data. In both courses of action, the main attacking forces, the 52d and 53d Mech, reach 70 percent of remaining tank capability about 24 hours after the attack begins, and reach 40 to 45 percent at day 3.

(Slide 36)

In both courses of action, the 54th Mech reaches 70 percent in about 30 hours, and 55 percent by day 3. In course of action 1, while conducting a demonstration, the 201st ACR reaches 70 percent in 12 hours, and 43 percent at day 3. In course of action 2, the 23d Armored Division reaches 70 percent in a day-and-a-half and 65 percent at day 3.

(Slide 37)

In both courses of action, the 25th Armored Division reaches 70 percent midway in the third day and 61 percent at day 3. In course of action 1, the 23d Armored Division reaches 70 percent after about two days and 51 percent at day 3. In course of action 2, the 201st ACR reaches 70 percent in 36 hours and 65 percent at day 3.

(Slide 38)

The greatest difference between the courses of action relates to losses associated with the supporting attack and the demonstration, by the 23d Armored Division in course of action 2 and the 201st ACR in course of action 1. Recall that tank losses for the 54th Mech were about the same for both courses of action. However, losses for the units conducting the supporting attack, the 23d Armored Division, and the demonstration, 201st ACR, were higher. Thus the summary shows the relative costs of each course of action in terms of tank losses.

Assuming this worst case, at the end of three days, what implications does the projected tank picture have for our posture as it relates to the mission of defending at the international boundary, or continuing the attack? What reorganization for combat might have to be made for performing either mission? What critical factors must be addressed in maintenance support planning, such as recovery, evacuation, cannibalization, and priorities of repair for major weapon systems? These are but examples of considerations that the planners might address.

We suspect that many other requirements would become apparent from a study of comparisons such as the one presented here. These requirements might be emphasized by other comparisons of Classes III or V, or of personnel. If the methodology incorporated your conditions and assumptions, and used contemporary planning factors, we believe it could aid your planning efforts. (PAUSE)

(Slide 38 OFF)

Gentlemen, time doesn't permit us to show you all of the displays that the methodology can generate. Instead, we've tried to give you an insight into its capabilities, with examples of how it might be used. Quite possibly, applications of the methodology have already occurred to you that we haven't even considered. It can generate an enormous amount of information, more than enough to inundate the staff. However, the application of the methodology is under control of the user. Beginning with the overview, he can apply it selectively, developing only the information that meets his particular needs. In this way, he can find the weak links in the corps assets, and then bring them to the commander's attention.

What you've seen today obviously concentrates on the use of the methodology at the level of corps. Nonetheless, we know of no reason why it wouldn't work as well at division level, or at brigade, or even battalion. At each of those echelons, we believe it could help the one and the four to detect admin/log problems that might arise during an impending operation. We also believe it could help them considerably to identify the sources of those prospective problems. In these ways, we believe the methodology provides a valuable tool to help the one and the four carry out their responsibilities to the commander and the rest of the planning staff. The question we'd like to ask now is: Do you agree?

To help obtain your answers to that question, we've prepared a short questionnaire. It will take only a few minutes to fill out, and it will help us greatly to assess the methodology's worth.

I'd like to emphasize that this methodology is NOT a finished product. At this stage, it's largely a concept which may be included in future tactical data processing systems. Whether or not anybody does any further work on it will depend in considerable degree on your reactions. Our development of the methodology was based on information we gathered during our last visit to USAREUR. The questionnaire is your opportunity to provide further information about your requirements in case additional work is done to complete its development. Gentlemen, do you have any questions?

(Slide 16)

FM 101-10-1 Update:

Replacement Forecast	=	Unit Strength	x	Operational Factors	x	Branch/function Vulnerability Factor
	x	Grade Factor by Density	x	3-digit MOS/SSI Vulnerability Factor		

(Slide 17)

FUEL FORECASTING MODELS

A. Wheeled Vehicles

# of miles traveled x consumption factor x density

B. Aircraft and Stationary Equipment

# of hours operated x consumption factor x density

C. Tracked Vehicles

(# hours idle x idling consumption factor + # hours on secondary roads x road consumption factor + # hours traveling cross-country x cross-country consumption factor) x density

(Slide 18)

REQUIREMENTS FOR THE DATA BASE

1. Equipment
   - A. Line numbers for all equipment items that use fuel
   - B. Numbers of items authorized
   - C. Numbers of items operational
   - D. Fuel types
   - E. Amount of each fuel type on hand
   - F. Use factors or fuel consumption factors
   - G. Ammo types
   - H. Amount of each ammo type on hand
   - I. Ammo consumption factors
   - J. Group definitions (IAW commander's guidance)
   - K. Loss factors
2. Personnel
   - A. Numbers of personnel in each MOS or SSI and grade
   - B. Definitions of branch or functional area
   - C. Group definitions (IAW commander's guidance)
   - D. Planning factors
3. Task Organization

(Slide 19)

SEQ	LINE NO	GROUP	FUEL TYPE	USE FACT	FUEL CONSUMPTION RATES			AMMO TYPE	AMMO CONSUMPTION RATES			LOSS RATE
					IDLE	X-CTY	SC RD		1ST	SUCCD	PROTR	
1	A30946	2	JP	4.0	115.4	0.0	0.0		0	0	0	.300
2	A93125	4	DE	0.0	1.0	10.2	12.8	152	7	4	2	.150
3	B83582	5	MO	12.0	12.5	0.0	0.0		0	0	0	.200
4	D10726	4	DE	0.0	1.0	6.3	8.7	87	121	66	37	.150
5	D10741	1	DE	0.0	1.0	7.0	9.7		0	0	0	.200
6	D11049	1	DE	0.0	1.0	6.2	8.9		0	0	0	.200
7	D11401	1	DE	0.0	1.0	6.8	8.8		0	0	0	.200
8	D11538	1	DE	0.0	1.0	6.8	8.8		0	0	0	.200
9	D11681	3	DE	0.0	1.0	5.0	7.5	TOW	7	8	4	.200
10	D12087	1	DE	0.0	1.0	6.2	8.9		0	0	0	.200
11	E56578	4	DE	0.0	5.3	20.6	33.8		0	0	0	.150
12	E67735	5	MO	0.0	1.0	0.0	0.0		0	0	0	.100
13	E69242	5	MO	12.0	1.0	0.0	0.0		0	0	0	.100
14	E70064	5	MO	12.0	1.0	0.0	0.0		0	0	0	.100
15	E70201	5	MO	12.0	1.0	0.0	0.0		0	0	0	.100
16	E70817	5	MO	12.0	1.0	0.0	0.0		0	0	0	.100
17	E70886	5	MO	12.0	3.3	0.0	0.0		0	0	0	.100
18	E73626	5	MO	12.0	1.0	0.0	0.0		0	0	0	.100
19	E74037	5	MO	12.0	1.0	0.0	0.0		0	0	0	.100
20	F39241	1	DE	12.0	10.8	0.0	0.0		0	0	0	.200
21	F39378	1	DE	12.0	6.0	0.0	0.0		0	0	0	.200
22	H94824	5	MO	12.0	1.5	0.0	0.0		0	0	0	.200
23	J35492	5	DE	12.0	3.5	0.0	0.0		0	0	0	.100
24	J35629	5	DE	12.0	4.2	0.0	0.0		0	0	0	.100
25	J35680	5	DE	12.0	0.0	0.0	0.0		0	0	0	.100
26	J35801	5	DE	12.0	3.5	0.0	0.0		0	0	0	.100
27	J35813	5	DE	12.0	3.5	0.0	0.0		0	0	0	.100
28	J35825	5	DE	12.0	0.0	0.0	0.0		0	0	0	.100
29	J35835	5	DE	12.0	3.5	0.0	0.0		0	0	0	.100
30	J36109	5	DE	12.0	4.2	0.0	0.0		0	0	0	.100
31	J36383	5	DE	12.0	4.2	0.0	0.0		0	0	0	.100
32	J36725	5	DE	12.0	8.0	0.0	0.0		0	0	0	.100
33	J38301	5	DE	12.0	8.0	0.0	0.0		0	0	0	.100

(Slide 20)

DATA BASE FOR TANK BATTALION

Equipment

SEQ	LINE NO	OH	GROUP	FUEL TYPE	USE FACT	FUEL CONSUMPTION RATES			AMMO TYPE	AMMO EXPEND RATE		LOSS RATE
						IDLE	X-CTY	SC RD		1ST	SUCCD	
89	X38961	1	5	MO	62.5	0.1	0.0	0.0		0	0	.200
94	X39440	7	4	DE	62.5	0.1	0.0	0.0		0	0	.200
105	X40009	14	4	MO	62.5	0.1	0.0	0.0		0	0	.200
107	X40146	6	4	MO	62.5	0.2	0.0	0.0		0	0	.200
116	X41310	6	4	DE	62.5	0.2	0.0	0.0		0	0	.200
118	X41615	5	4	DE	62.5	0.3	0.0	0.0		0	0	.200
128	X58093	4	4	DE	62.5	0.2	0.0	0.0		0	0	.200
134	X60833	34	4	MO	62.5	0.0	0.0	0.0		0	0	.200
138	X63436	1	4	DE	62.5	0.2	0.0	0.0		0	0	.200
5	D10741	4	1	DE	0.0	1.0	7.0	9.7		0	0	.200
7	D11401	9	1	DE	0.0	1.0	6.8	8.8		0	0	.200
8	D11538	6	1	DE	0.0	1.0	6.8	8.8		0	0	.200
10	D12087	9	1	DE	0.0	1.0	6.2	8.9		0	0	.200
79	R50544	1	1	DE	0.0	1.0	11.3	15.2		0	0	.150
80	R50681	5	1	DE	0.0	5.3	23.9	41.0		0	0	.150
83	V13101	54	1	DE	0.0	5.3	24.6	34.3	105	65	35	.400

PERSONNEL -- TOE STRENGTHS

	IN	AR	FA	AD	AV	EN	MC	SC	QM	MI	OD	CM	TC	MP	AG
OFF	0	31	0	1	0	0	1	1	0	2	0	2	0	0	0
WO	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
ENL	26	281	0	11	0	0	20	12	53	1	103	0	11	0	21

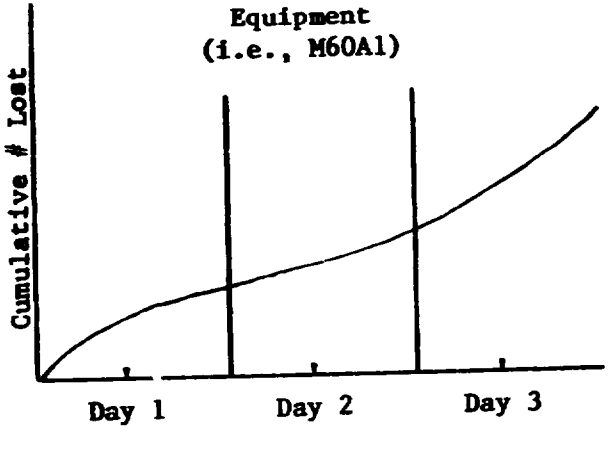
(Slide 21)

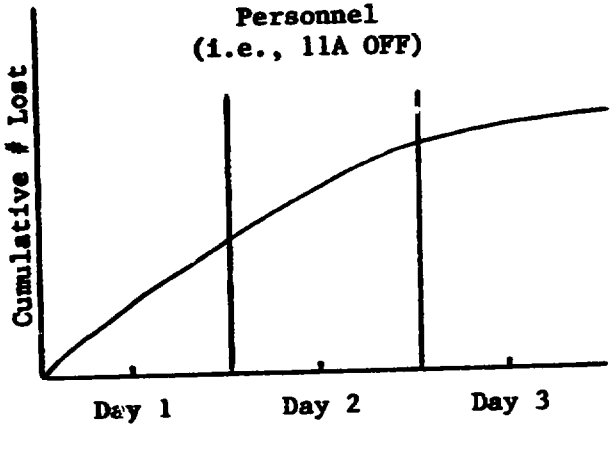
INPUTS TO THE METHODOLOGY

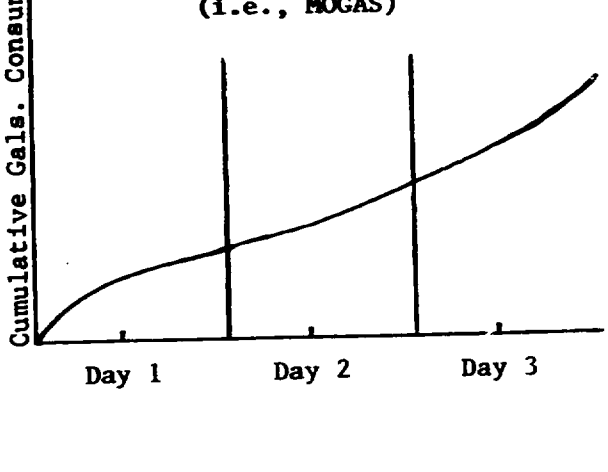
1. Unit identification
2. Percentage strength of the unit
3. Mission
4. Course of action number
5. Task organization
6. Length of operation
7. Lengths of time intervals into which operation is divided
8. Distance to be travelled in each interval
9. Percentage of distance that will be travelled on roads
10. Estimate of combat intensity in each interval
11. Type of output desired
    A. graphic or tabular
    B. overview, grouped, or individual forecasts

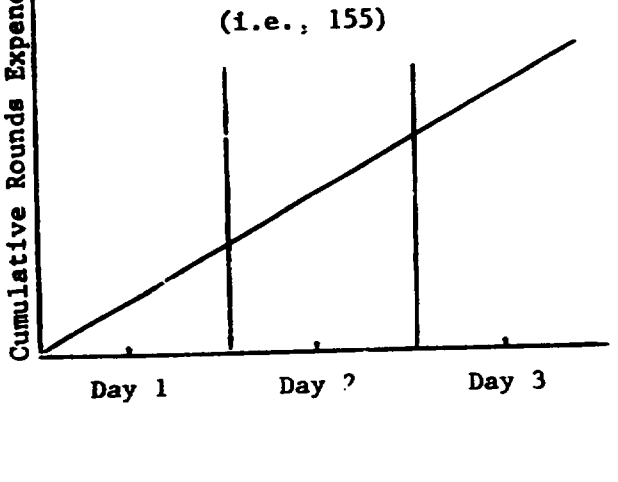
(Slide 22)

OUTPUTS FROM ADMIN/LOG MODELS

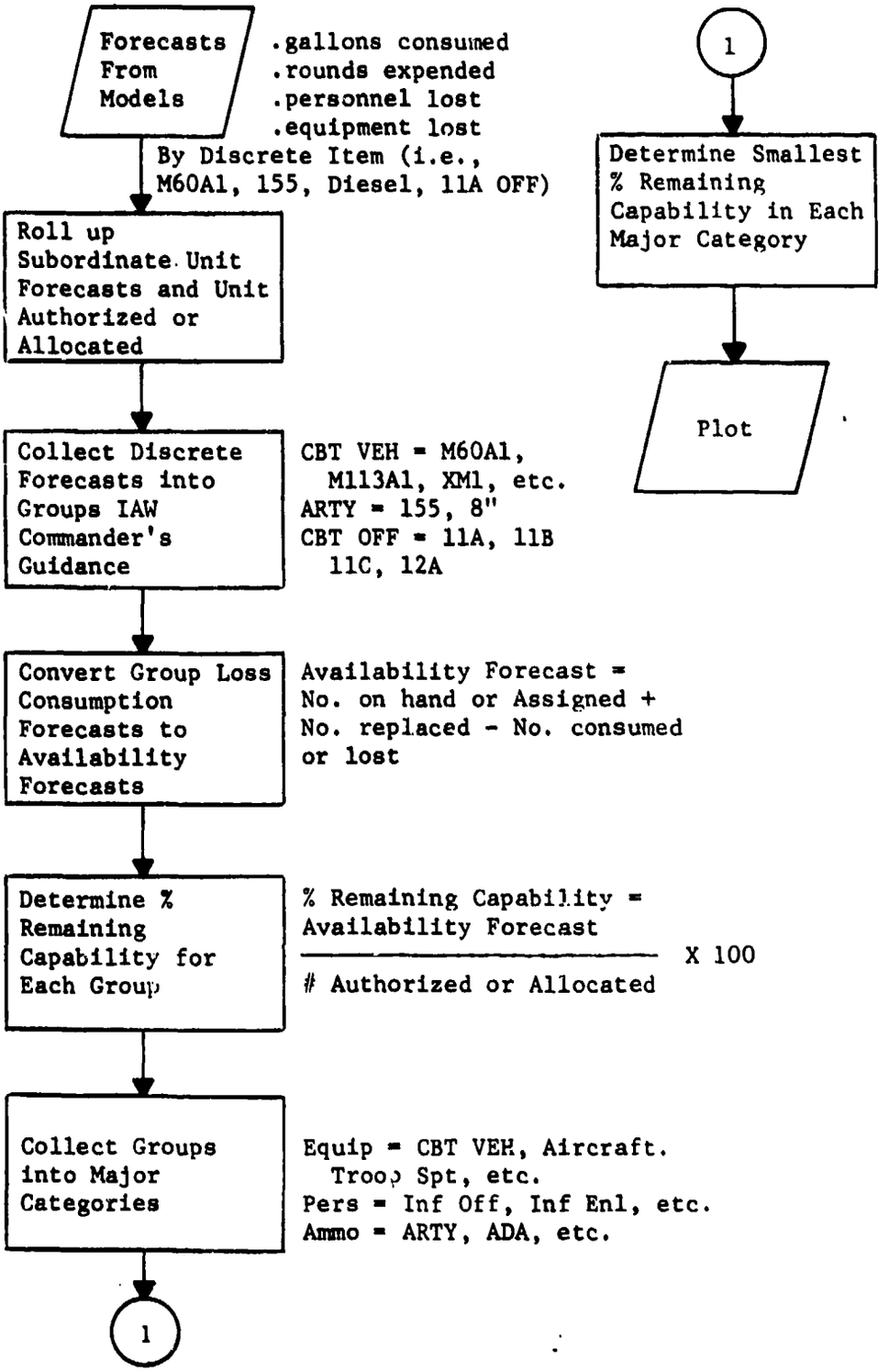








(Slide 23)


Forecasts From Models
.gallons consumed
.rounds expended
.personnel lost
.equipment lost
By Discrete Item (i.e., M60A1, 155, Diesel, 11A OFF)
Roll up Subordinate Unit Forecasts and Unit Authorized or Allocated
Collect Discrete Forecasts into Groups IAW Commander's Guidance
CBT VEH = M60A1, M113A1, XM1, etc.
ARTY = 155, 8"
CBT OFF = 11A, 11B 11C, 12A
Convert Group Loss Consumption Forecasts to Availability Forecasts
Availability Forecast = No. on hand or Assigned + No. replaced - No. consumed or lost
Determine % Remaining Capability for Each Group
% Remaining Capability = Availability Forecast / # Authorized or Allocated X 100
Collect Groups into Major Categories
Equip = CBT VEH, Aircraft. Troop Spt, etc.
Pers = Inf Off, Inf Enl, etc.
Ammo = ARTY, ADA, etc.
1
1
Determine Smallest % Remaining Capability in Each Major Category
Plot

(Slide 24)

EQUIPMENT

C/A 1

% OF REMAINING CAPABILITY

	I1	I2	I3	I4	I5
MSL Equip	(83)	(77)	74	70	68
Tactical Equip	90	84	79	75	68
Troop Spt	95	94	92	91	88
Combat Equip	89	83	77	73	66
Air Equip	94	82	(73)	(65)	(56)

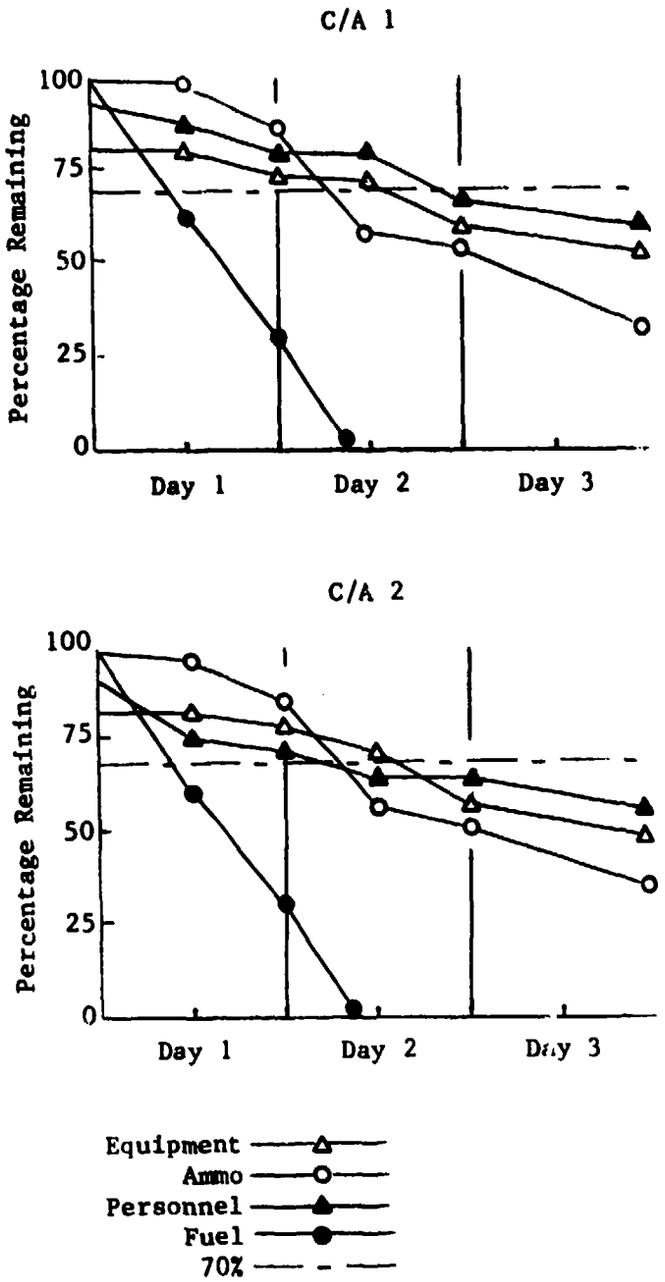
C/A 2

% OF REMAINING CAPABILTIY

	I1	I2	I3	I4	I5
MSL Equip	(83)	(77)	(71)	67	62
Tactical Equip	87	81	76	71	65
Troop Spt	93	91	90	88	86
Combat Equip	89	82	77	72	65
Air Equip	94	82	72	(64)	(55)

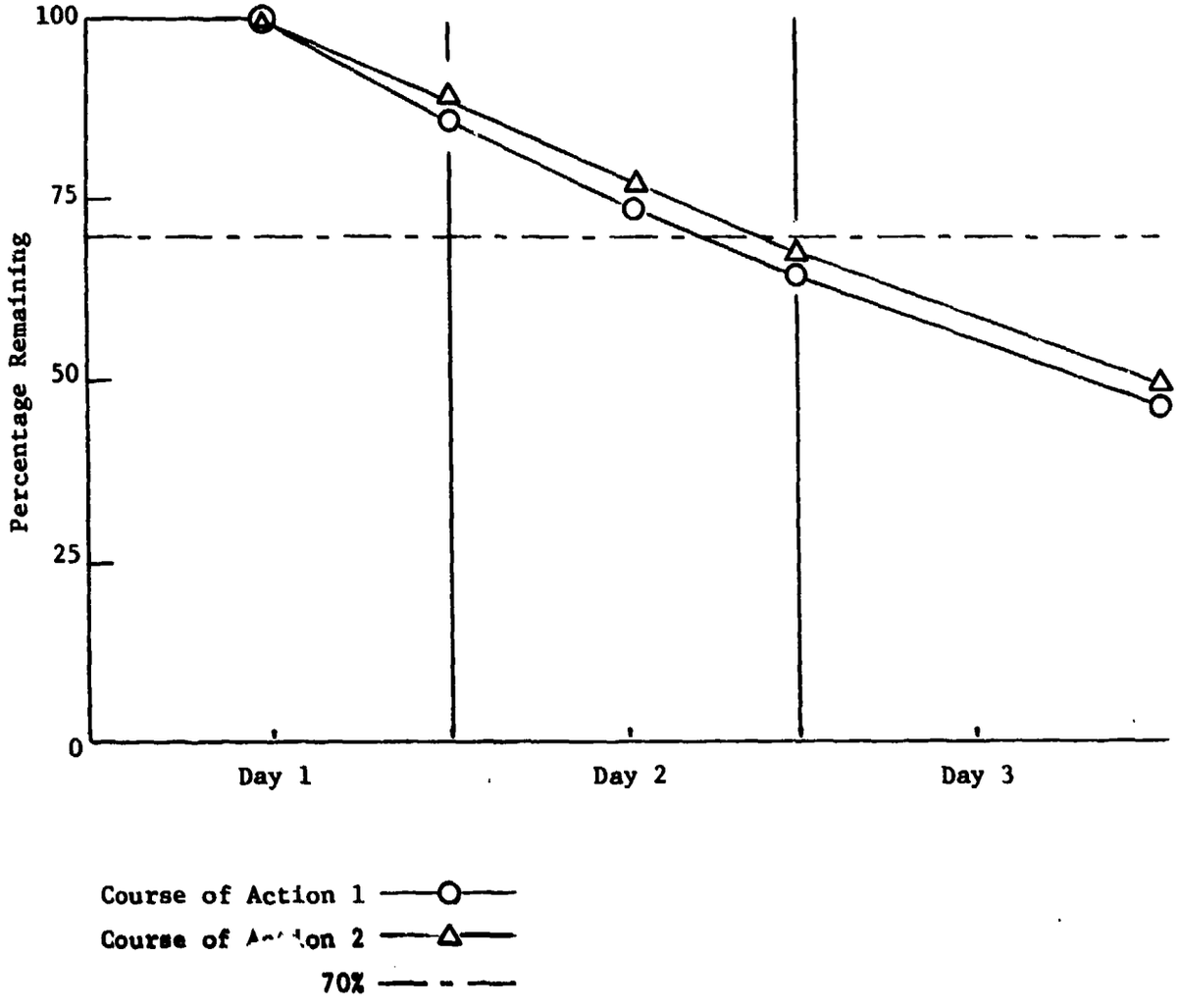
(Slide 25)

Percentage of Remaining Capability of Equipment, Fuel Ammo, and Personnel for Courses of Action 1 and 2



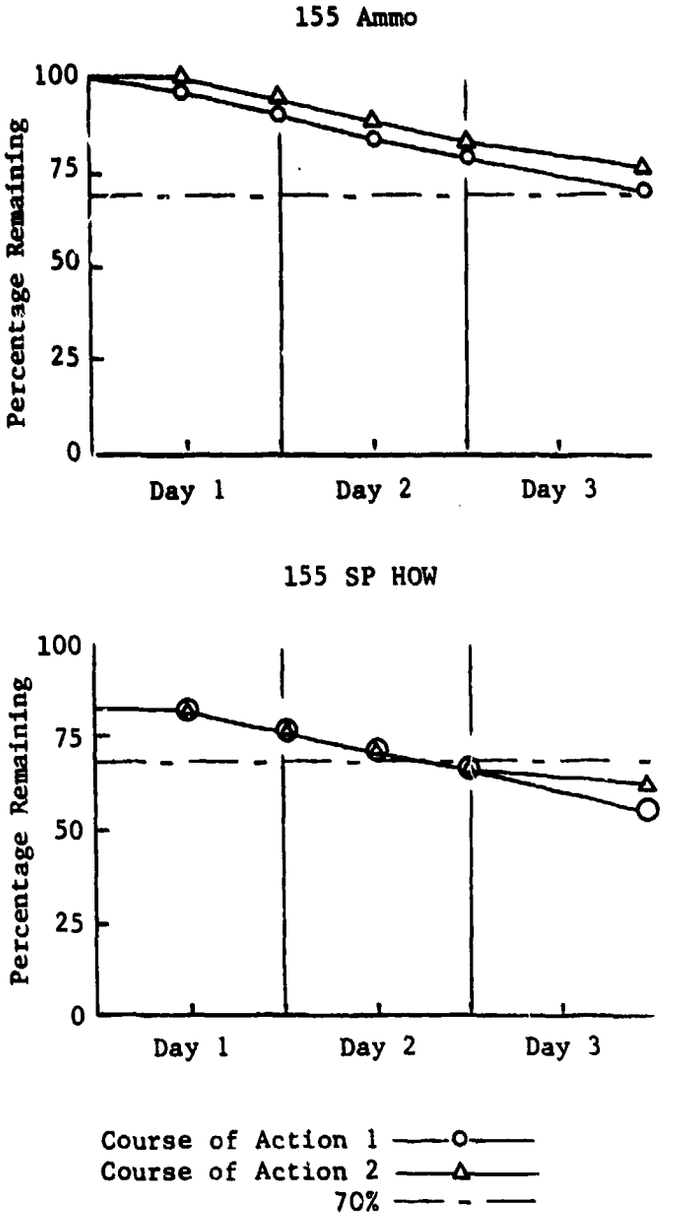
(Slide 26)

Percentage of Remaining Capability of 8" Ammo for Courses of Action 1 and 2



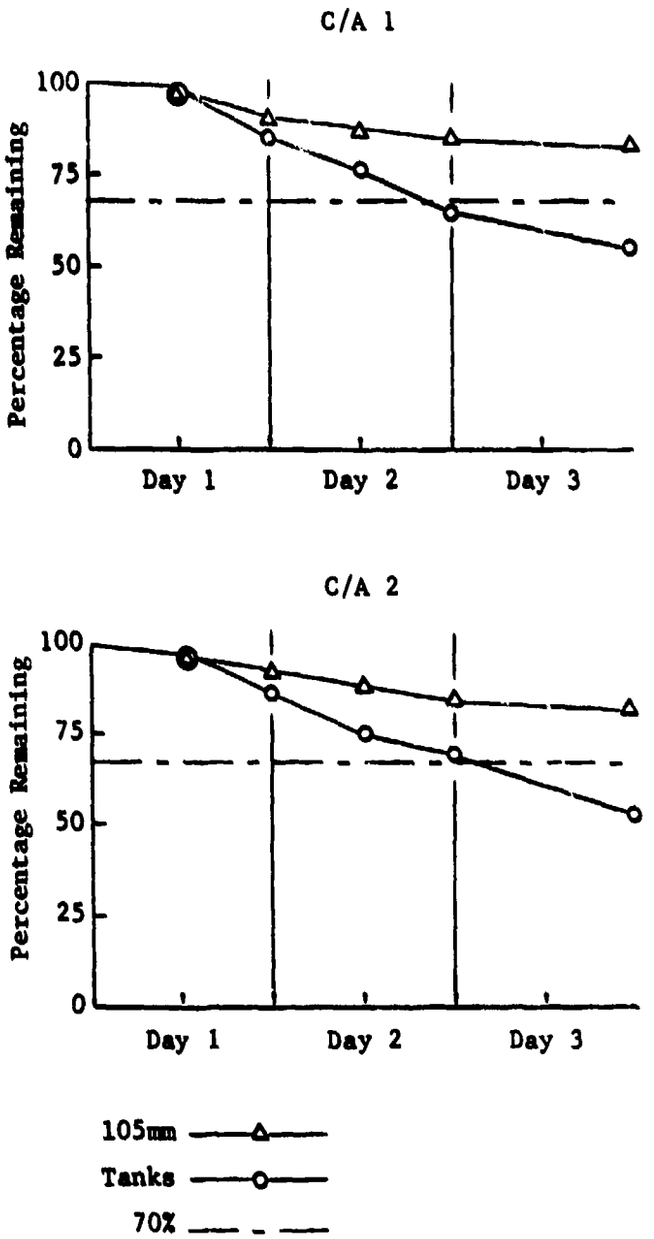
(Slide 27)

Percentage of Remaining Capabiliy of 155 Ammo and 155 SP HOW for Courses of Action 1 and 2



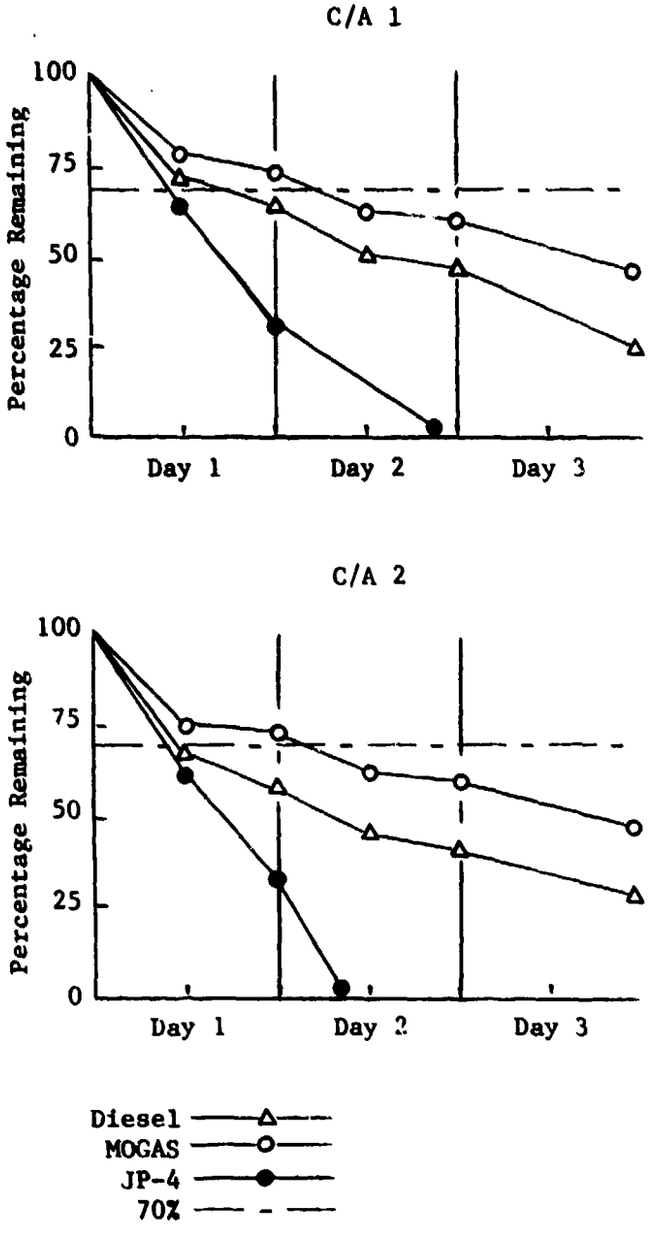
(Slide 28)

Percentage of Remaining Capability of 105mm and Tanks for Courses of Action 1 and 2



(Slide 29)

Percentage of Remaining Capability of Diesel, MOGAS, and JP-4 for Courses of Action 1 and 2



(Slide 30)

FUEL ALLOCATION

C/A 1

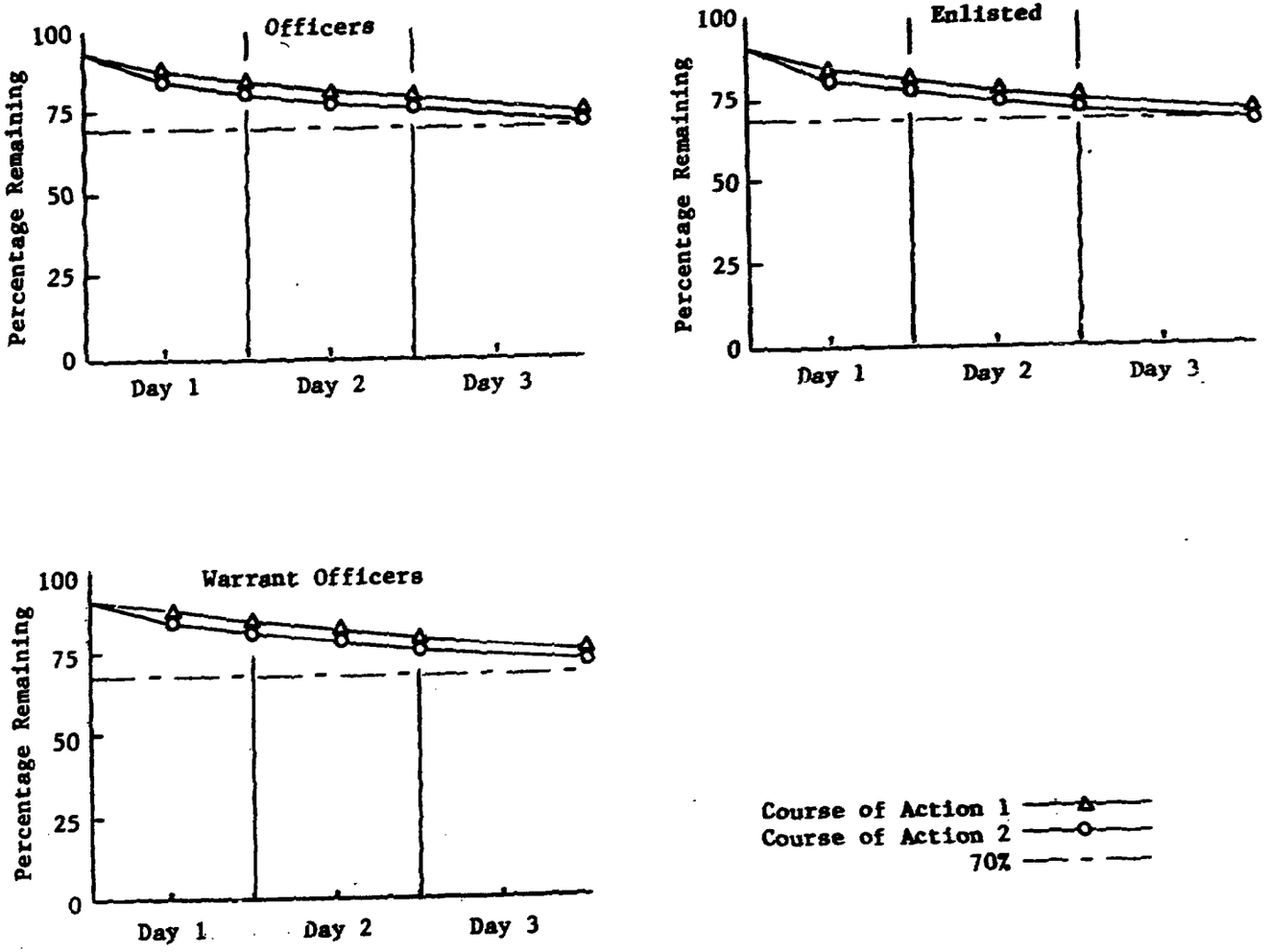
	Forecasted Requirement	Percentage of Requirement Received
1st Day	191,638 gal. MOGAS	25%
	711,404 gal. JP-4	27%
	1,235,321 gal. Diesel	19%
2nd Day	118,341 gal. MOGAS	40%
	438,691 ga. JP-4	44%
	713,845 gal. Diesel	33%
3rd Day	134,300 gal. MOGAS	36%
	379,430 gal. JP-4	51%
	787,691 gal. Diesel	30%

C/A 2

	Forecasted Requirement	Pipeline Supply
1st Day	202,734 gal. MOGAS	23%
	709,646 gal. JP-4	27%
	1,396,987 gal. Diesel	17%
2nd Day	118,749 gal. MOGAS	40%
	458,828 gal. JP-4	42%
	739,594 gal. Diesel	32%
3rd Day	114,920 gal. MOGAS	42%
	376,594 gal. JP-4	51%
	631,458 gal. Diesel	38%

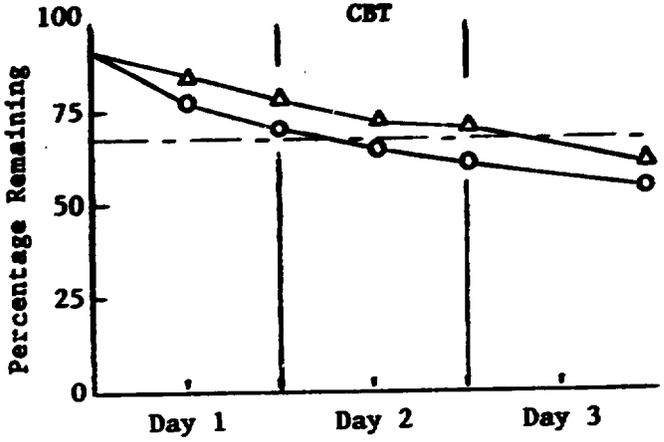
(Slide 31)

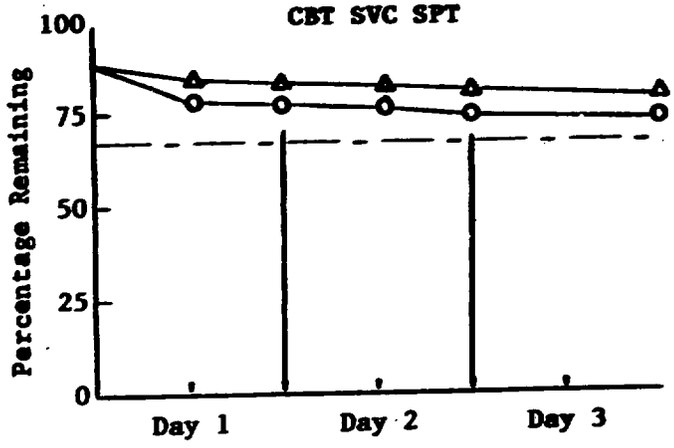
Percentage of Remaining Capability of Officers, Warrant Officers, and Enlisted Soldiers for Courses of Action 1 and 2

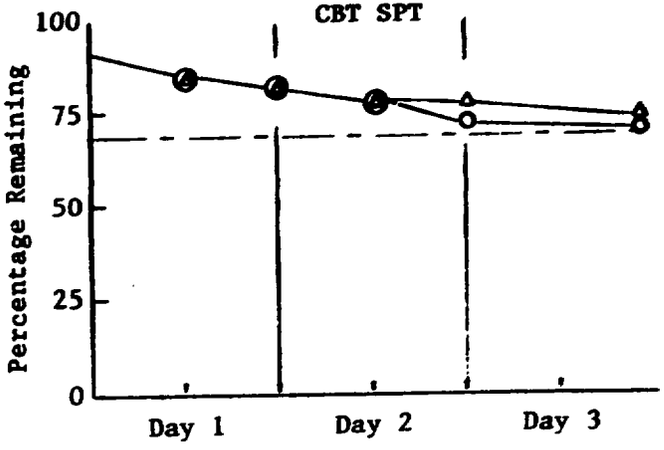


(Slide 32)

Percentage of Remaining Capability of Combat, Combat Support and Combat Service Support for Courses of Action 1 and 2







CCourse of Action 1
Course of Action 2
70%

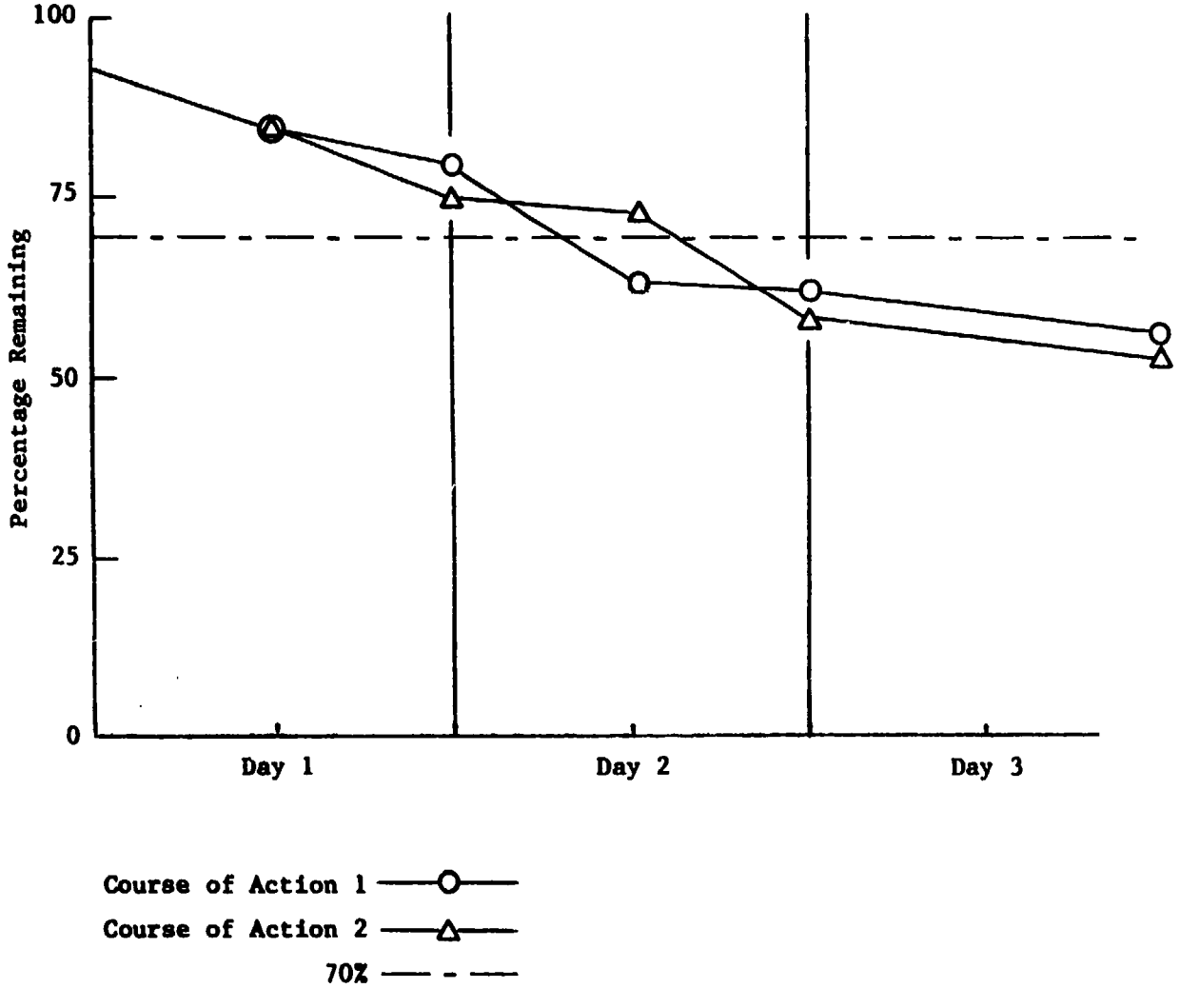
(Slide 33)

Personnel Forecast by Grade and Group

		CBT		CBT SPT		CBT SVC SPT	
Interval	Grade	C/A 1	C/A 2	C/A 1	C/A 2	C/A 1	C/A 2
1	O	86	79	84	85	83	88
	W	-	-	92	87	86	85
	E	86	80	85	85	87	84
2	O	80	73	82	83	82	87
	W	-	-	89	84	83	81
	E	79	74	82	82	86	84
3	O	75	68	80	81	81	85
	W	-	-	87	82	80	78
	E	74	68	79	79	85	83
4	O	71	63	79	79	80	84
	W	-	-	84	79	77	75
	E	69	62	77	76	84	82
5	O	65	58	76	76	78	83
	W	-	-	80	75	73	72
	E	62	56	73	72	83	81

(Slide 34)

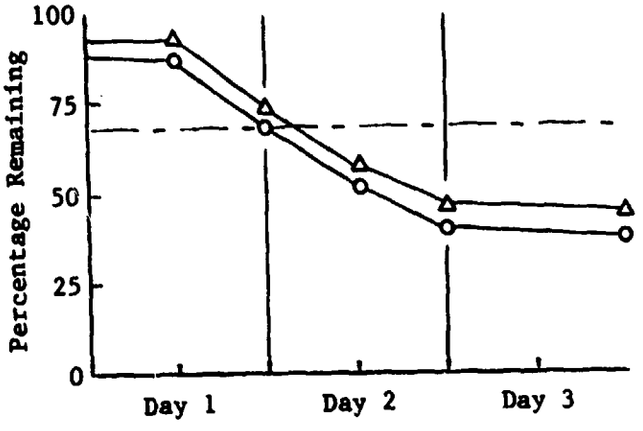
Percentage of Remaining Capability of Enlisted Infantry for Courses of Action 1 and 2



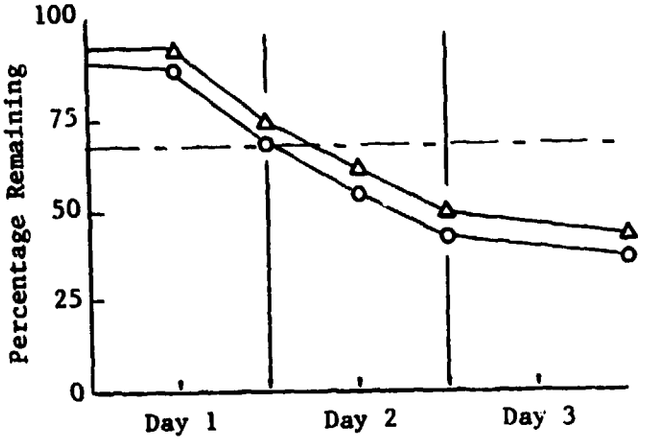
(Slide 35)

Percentage of Remaining Capability for Tanks in Main Attack Forces

C/A 1



C/A 2

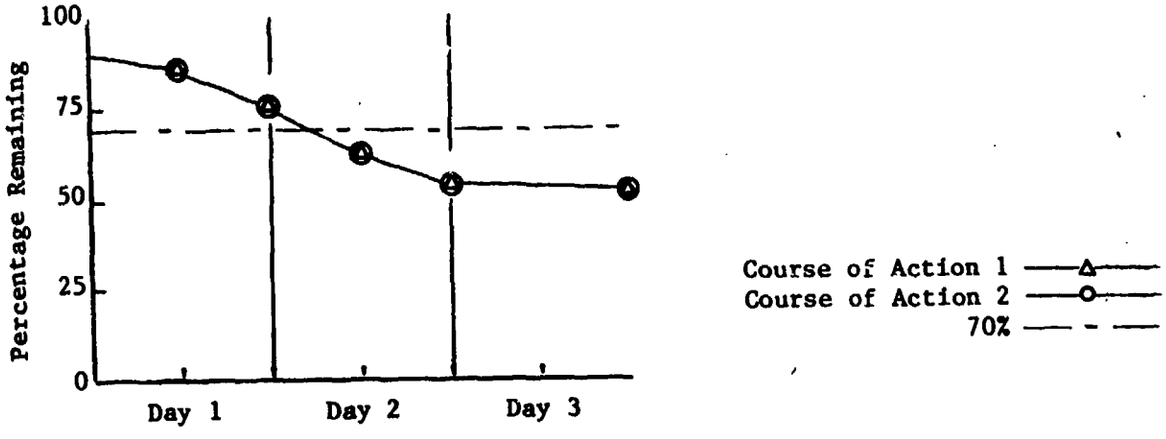


53rd —△—
52nd —○—
70% - - -

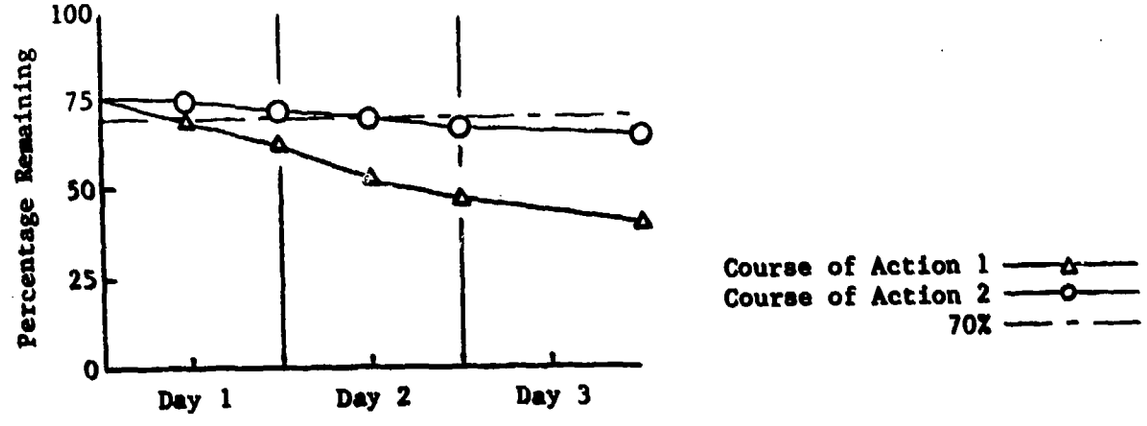
(Slide 36)

Percentages of Remaining Capability for Tanks
in Supporting Attack and Demonstration Forces

54th Mech



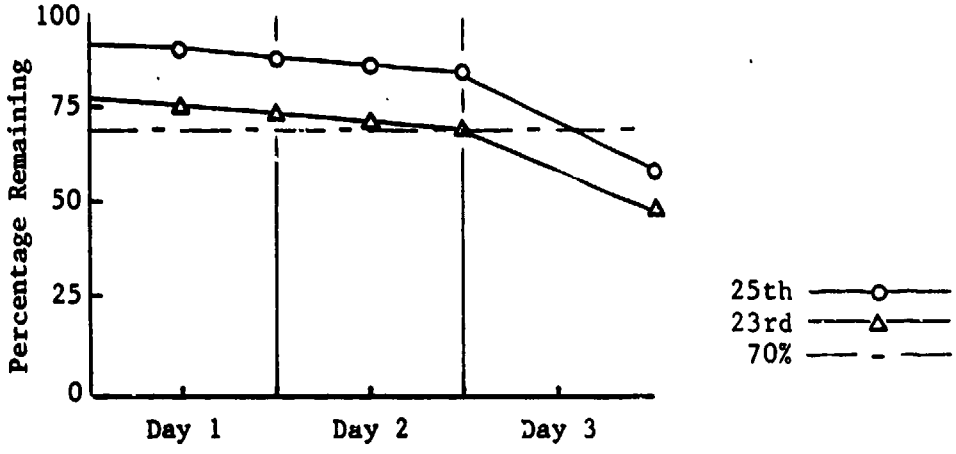
201st - 23rd



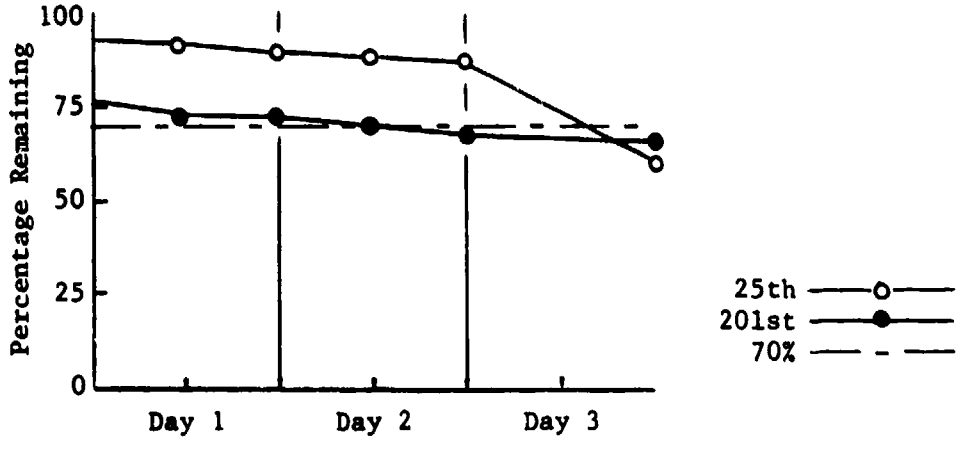
(Slide 37)

Percentages of Remaining Capability for Tanks in Following and Exploiting Forces

C/A 1



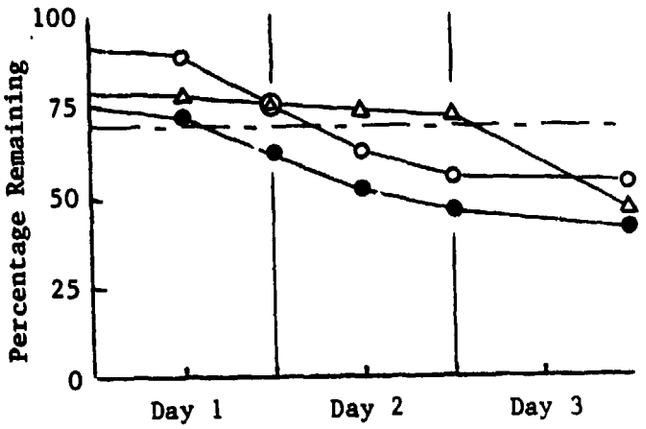
C/A 2



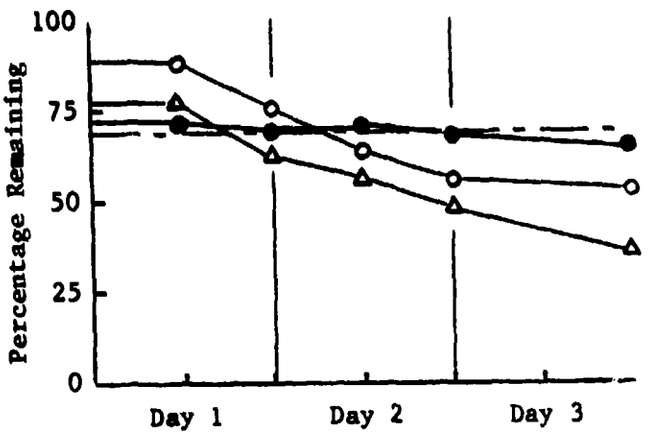
(Slide 38)

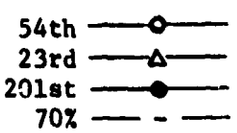
Summary of Percentages of Remaining Capability for Tanks in Supporing Attack and Demonstration Forces

C/A 1



C/A 2





APPENDIX D

Acronyms and Abbreviations

Acronyms and Abbreviations

ABIC	Automated Battlefield Integration Concept
AC^2MP	Army Command and Control Master Plan
ACofS	Assistant Chief-of-Staff
AD	Armored Division
ADMIN	Administration
ADMINCEN	Administration Center
ADP	Automatic Data Processing
AFSCENT	Allied Forces Central Europe
AG	Adjutant General
AMMO	Ammunition
ARI	Army Research Institute
AVGAS	Aviation Gas
BDE	Brigade
BN	Battalion
C^3I	Command, Control, Communications & Intelligence
C/A	Course of Action
CAA	Concepts Analysis Agency
CACDA	Combined Arms Combat Developments Activity
CASE	Corps and Subordinate Echelons
CATRADA	Combined Arms Training Developments Activity
CCIS	Command, Control and Information System
CENTAG	Central Army Group
CG	Commanding General
CGSC	Command and General Staff College
COSCOM	Corps Support Command
CONUS	Continental United States
COTR	Contracting Officer's Technical Representative
CSR	Corps Controlled Supply Rate
CSS	Combat Service Support
DA	Department of the Army
DIV	Division
DLDED	Division Level Data Entry Device
DOS	Days of Supply
DS	Direct Support
GS	General Support
IAW	In Accordance With

JIFFY	Name Given to Corps Level Wargame
JOPS	Joint Operations Planning System
LOG	Logistics
LOGCEN	Logistics Center
LOGSITREP	Logistics Situation Report
MILPERCEN	Military Personnel Center
MOGAS	Motor Gasoline
MOS	Military Occupational Specialties
NATO	North Atlantic Treaty Organization
OH	On-Hand
OR	Operationally Ready
PERSCOM	Personnel Command
PERSITREP	Personnel Situation Report
PERSREP	Personnel Report
PLL	Parts Load List
POL	Petroleum, Oil and Lubricants
PRR	Personnel Requirements Reports
SAAS	Standard Army Ammunition System
SAILS	Standard Army Intermediate Level Supply Subsystem
SAMS	Standard Army Maintenance System
SDC	System Development Corporation
SIDPERS	Standard Installation Division Personnel System
SITREP	Situation Report
SPO	Security Plans and Operations
SSI	Special Skills Identifier
TC^2S	Tactical Command and Control System
TOE	Table of Organization and Equipment
TOS	Tactical Operations System
TPFDL	Time Phase Force Deployment List
TRADOC	Training and Doctrine Command
TSM TOS	TRADOC System Manager for the Tactical Operations System
USAREUR	United States Army Europe
WARF	Wartime Replacement Factors
WARRAMP	Wartime Requirements for Ammunition, Material, and Personnel
WSRO	Weapon System Replacement Operation

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